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SCIENTIFIC SURVEY
OF
Porto Rico and the Virgin Islands

VOLUME IX

NEW YORK:
PUBLISHED BY THE ACADEMY
1927

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Part 1, November 27, 1925.
Part 2, January 30, 1926.
Part 3, November 12, 1927.
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NEW YORK ACADEMY OF SCIENCES

SCIENTIFIC SURVEY
OF
Porto Rico and the Virgin Islands

VOLUME IX—Part 2

Mammals of Porto Rico, Living and Extinct—Rodentia and Edentata—*H. E. Anthony*

NEW YORK:
PUBLISHED BY THE ACADEMY
1926

MAMMALS OF PORTO RICO, LIVING AND EXTINCT*

BY H. E. ANTHONY

RODENTIA AND EDENTATA

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* For Chiroptera, Insectivora and the Introduction see Part 1 of this volume.

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Order RODENTIA

Family DINOMYIDAE

1918. Dinomyidae Miller and Gidley, Journ. Wash. Acad. Sci., VIII (13), p. 446, July 19.

Elasmodontomys Anthony

1916. *Elasmodontomys* Anthony, Ann. New York Acad. Sci., XXVII, p. 199, August 9.

1924. *Elasmodontomys* Winge, Pattedyr-Slaegter, II, p. 65, 163.

Type.—*Elasmodontomys obliquus* Anthony.

A large hystricomorph rodent with extremely hypsodont rootless molars, composed of alternating enamel plates and bands of dentine: five, and often six, enamel plates in each molar; large infraorbital foramen; heavy zygomatic arch; and massive mandible.

Distribution.—Known only from Porto Rico; fossil.

Elasmodontomys obliquus Anthony

Text Figs. 29–47, Plates XVI–XXVI, XXX

1916. *Elasmodontomys obliquus* Anthony, Ann. New York Acad. Sci., XXVII, p. 199, August 9.

1918. *Elasmodontomys obliquus* Anthony, Indigenous Land Mammals of Porto Rico, p. 380, October 12.

Type.—No. 14171, Dept. Vert. Pal., Amer. Mus. Nat. Hist. A fairly well-preserved skull lacking complete zygoma, the nasals, and with almost half of the posterior skull broken away; only one tooth, m^3 on the right, is missing.

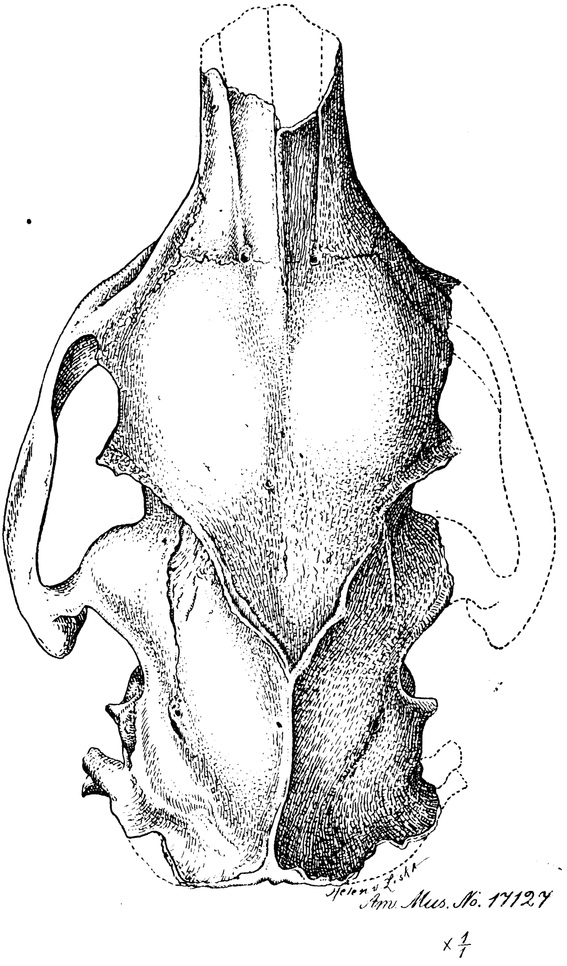

FIG. 29.—*Elasmodontomys obliquus.* Morovis, Porto Rico. × 1/1

Type locality.—Utuado, Porto Rico.

Distribution.—Known only from the Island of Porto Rico. Recorded in Porto Rico from Utuado, Morovis and Ciales (Ciales material in Mus. Comp. Zoöl.).

General characters.—A very large hystricomorph rodent with hypsodont, rootless molars, the crown patterns of which are made up of five to six enamel plates and connecting dentine.

Skull.—(Text Figs. 29-33.) Large and strongly constructed; superior outline nearly straight; rostrum short and heavy, much deeper than wide; nasals long, widening slightly anteriorly, well arched laterally above plane of maxillæ; premaxillary suture with frontal in same plane as nasal suture; interorbital region very broad, with strong, wide, postorbital processes; an abrupt postorbital pinching-in of braincase, which is constricted and compressed throughout parietal region; a strongly developed sagittal crest with well-marked anterior bifurcation, which runs out, as a ridge, on either side into the postorbital process; high lambdoidal crest; infraorbital foramen large; zygomatic arch very strong and broad. Malar very broad, with low, rounded, postorbital eminence, and entering into glenoid as a deep, square shoulder; posterior zygomatic root massive; part of orbit reserved for eyeball exceptionally small; root

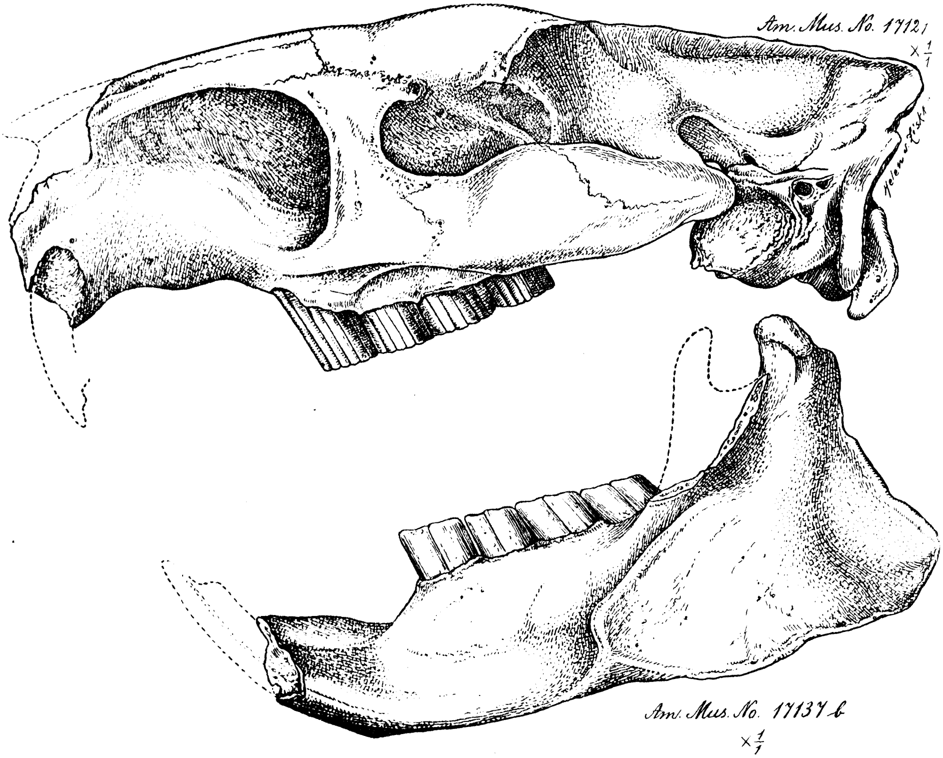

Fig. 30.—*Elasmodontomys obliquus Mororis.* Porto Rico. × 1/1

of incisor producing a slight swelling across face of premaxilla and maxilla; palate of moderate length, closely constricted anteriorly by converging tooth-rows; diastema of good length; incisive foramina large and

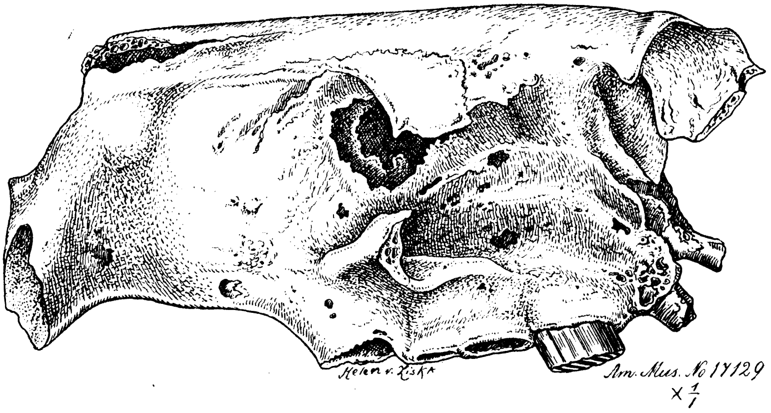

FIG. 31.—*Elasmodontomys obliquus.* Utuado, Porto Rico. × 1/1

opening from side, postpalatal notch wide and deep, reaching nearly to line of anterior border of m³, a median ridge along palate between molars, and six noticeable palatal foramina; pterygoid processes heavy

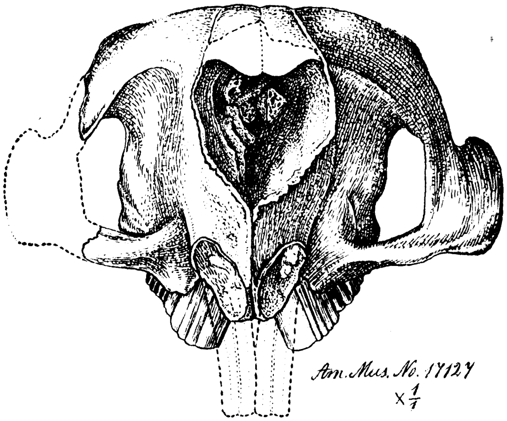

FIG. 32.—*Elasmodontomys obliquus.* Morovis, Porto Rico. × 1/1

and broad, with deep, extensive pterygoid fossa; bullæ of medium size, somewhat compressed; paroccipital processes long and strong.

Mandible.—(Text Fig. 34.) Like the skull, the mandible is strong and massive; horizontal ramus deep and thick, its ventral border nearly straight; ascending ramus narrower; coronoid well-formed but narrow and rather weak proportionally, condyle as high as coronoid with well-rounded and extensive head; angular process very broad and massive; a very good attachment for the internal pterygoid muscle provided by expanded lower border of ramus and angular process.

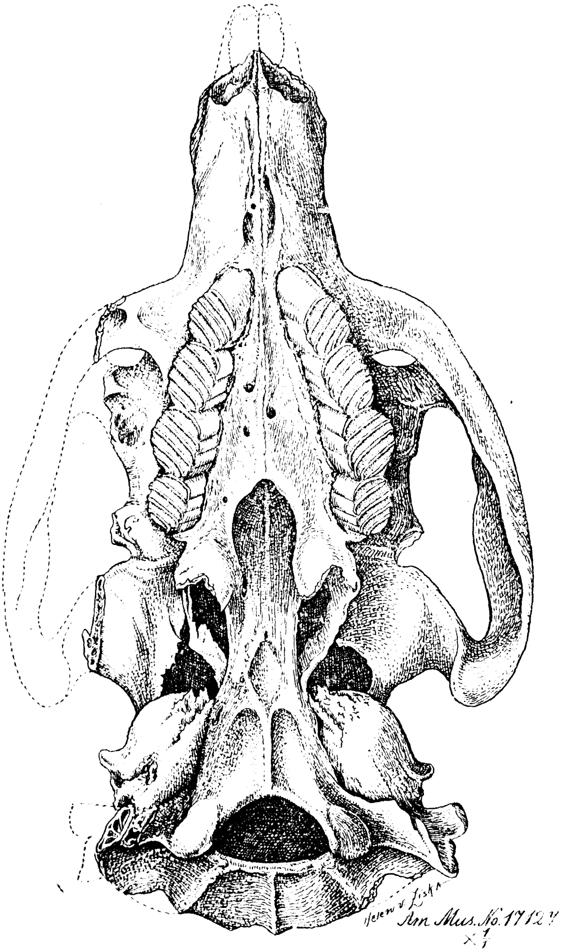

Fig. 33. *Elasmodontomys obliquus.* Morovis, Porto Rico. × 1/1

Dentition.—I, $\frac{1-1}{1-1}$; Pm, $\frac{1-1}{1-1}$; M, $\frac{3-3}{3-3}$ = 20 **(Text Fig. 35.)**

Upper: Incisors long, curving and of rather small size proportionally, deeper antero-posteriorly than wide, with faint, median, longitudinal concavity on face of enamel, tips notched rather squarely; premolars and molars all hypsodont, deeply set into maxilla, rootless, and each tooth of nearly uniform cross-section from crown to base; molar series inclined to rear and each row divergent from the other at crown and base, but curving inward about middle; the individual tooth made up of five main enamel laminæ with alternating layers of dentine, this number of laminæ often increased to six by a small, posterior plate; laminæ approximately parallel to one another in the tooth, but decidedly oblique to long axis of palate; premolar roughly trigonal in cross-section, molars subquadrate to subcircular.

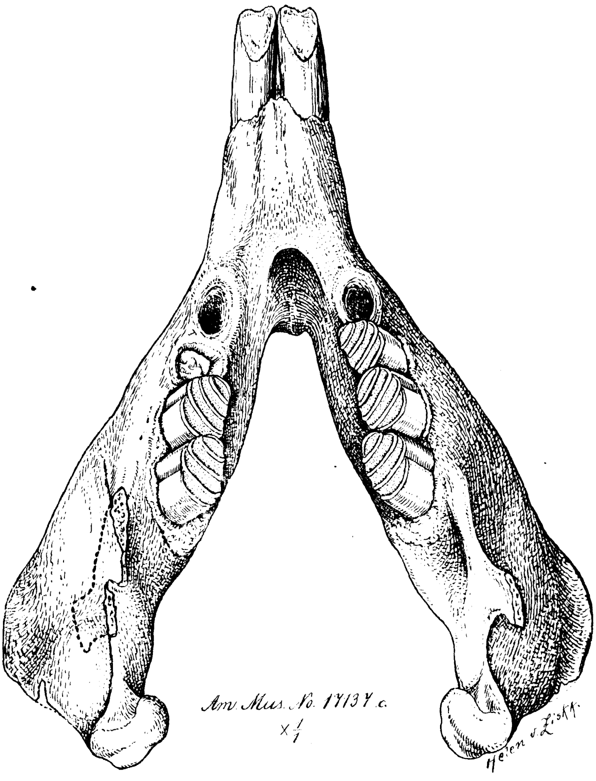

FIG. 34.—*Elasmodontomys obliquus.* Morovis, Porto Rico. × 1/1

Lower: Incisors not as strongly curved as above, with well-marked longitudinal groove and tips chisel-like; molar series as above, but enamel alternated with dentine in the reverse order, the teeth not curved from crown to base, but inclined forward to ramus; number of laminæ four.

The *Elasmodontomys* molar is a highly specialized development from the more primitive, infolded crown pattern. Doubtless the early condition of the molar was something like that seen in typical Echimyidae—*Proechimys,* for example. With the progressive invasion of the enamel loops which eventually completely crossed the crown transversely, the mechanics of mastication, possibly, have produced the thickening of one wall of the loop and reduced the other. Regardless of what the cause may have been, the anterior enamel wall of each loop in the upper molars and the posterior wall in the lower molars is greatly thickened and the respective opposing walls of the loop are so reduced as to be visible only under a microscope. In slightly weathered specimens the molar laminæ part readily from one another, the line of parting being between the thickened enamel wall of one plate and the reduced, semi-obsolescent enamel wall of its neighbor.

Skulls collected.—16, of which 3 are almost complete; 15 good-sized fragments, and a number of teeth and smaller broken portions.

Mandibles collected.—39 rami, of which a few present nearly all the characters; and a large number of fragments and teeth.

Measurements of Skull of Elasmodontomys obliquus

Catalog Number, Department of Vertebrate Palaeontology	Greatest length from lambdoidal crest to tip of premaxillae	Length from anterior border foramen magnum to tip of premaxillae	Zygomatic breadth	Interorbital breadth anterior to postorbital processes	Breadth across post-orbital processes	Least breadth of braincase	Least breadth of rostrum about midway	Depth of rostrum at premaxillary-maxillary suture	Length of nasals	Greatest breadth of nasals	Greatest breadth of jugal	Length of palate, post-palatal notch to posterior border of incisive alveoli	Least breadth of palate, inside pm^4	Greatest breadth of palate, inside m^3	Length of diastema	Alveolar length of maxillary molar series	Greatest dimensions of pm^4	Greatest dimensions of m^1	Greatest dimensions of m^2	Greatest dimensions of m^3	Dimensions of audital bulla
14171*...	124?	.....	.....	45?	.....	.....	20.5	34?	.....	.....	.....	58.	4.5	.....	30.5	33.5	8 x 8.5	7.2 x 7.8	7.8 x 9.1	7.4 x 7.8	20.5 x 10.4
17126....	123	98.	71.5	39.	43.5	34.	19.5	30.	33?	15	14.2	59.	4.5	20.	28.	34.	.....	.....	7.4 x 8.9	7.4 x 8.6	.....
17127....	122	97.6	70?	42.5	47.	32.8	19.2	30.8	.....	.....	15.4	57.2	2.6	20.	30.5	35.4	7 x 7.7	6.8 x 8.4	7.5 x 9.5	6 x 7	19 x 11
17128....	.....	.....	.....	.....	.....	.....	20.3	32.	38.5?	15.5?	.....	61.2	3.	20.	33.	36.5	.....	.....	7.7 x 8.1	7.5 x 8.9	.....
17129†...	.....	.....	.....	44.2		.....	24.	38.	43.5	20?	.....	72.	2.8	19.5	37.5	38.6	.....	.....	.....	8.4 x 10.2	.....
17130....	.....	.....	.....	40.8	50.	.....	.....	.....	.....	.....	.....	.....	3.	18.7	.....	34.	.....	7.2 x 8.3	7.2 x 8.3	7.2 x 8.7	.....
17131....	.....	.....	.....	.....	.....	.....	20.	33.3	34.2	14.6	.....	.....	4.	.....	30.	33.5	8 x 8	6.9 x 7.6	6.9 x 8.4	6 x 7.6	.....
17132†...	.....	.....	.....	37.7	40.6	.....	.....	30.5	.....	.....	.....	59.7	.....	16.7	30.	33.	8 x 9?	7.9 x 10?	7.1 x 11	.....	.....
17133....	.....	.....	.....	40.2	44.7	32.5	.....	.....	.....	.....	.....	.....	3.1	20.	.....	32.6	7.7 x 7.4	7.3 x 7.7	7.2 x 8	7.4 x 7.7	.....
17134....	.....	.....	.....	40.7	49.	.....	20.2	33.6	39.3	15.2	.....	61.5	3.6	21.5	30.	34.	7.8 x 8.3	7.6 x 8	7.2 x 9	6 x 8.1	.....
17135....	.....	.....	.....	.....	.....	.....	19.4?	33.	41.5	19.1	.....	.....	4.3	17.1	.....	34.6	7.5 x 8.7	7.5 x 8.8	7.3 x 10.4	4 x 5‡	.....
17136....	.....	.....	.....	.....	.....	.....	22.2	37.1	45.9	16.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

* Type.

† See special discussion under "Remarks."

‡ Tooth scarcely worn.

? Parts slightly broken or distorted, but accurate measurement still possible.

Measurements of Mandible of Elasmodontomys obliquus

	Total length from extreme posterior border of ascending ramus to tip of symphysis	Alveolar length of molar series	Length of diastema	Vertical depth of ramus at alveolus of m_1	Vertical depth from tip of condyle	Breadth of ascending ramus	Dimensions of pm_4	Dimensions of m_1	Dimensions of m_2	Dimensions of m_3
17137 a	....	33.	27.	22.	....	....	5.8 x 8.8	7.2 x 7.3	7.4 x 8.5	7.5 x 8.7
17137 b	86.5	34.5	22.5	21.5	43.5	....	5.7 x 7.6	7.1 x 6.7	7.2 x 8.3	6.6 x 6.7
17137 c*	87.7	34.6	27.8	22.	40.	26.8	....	6.5 x 8.8	7.1 x 8.7	....
17137 d	93.5	33.5	27.	20.5	44.3	....	....	....	6.5 x 7.9	6.6 x 9.3
17137 e	....	33.9	....	20.8	....	....	6.4 x 8	6.7 x 7	7 x 8.5	6.5 x 8
17137 f	....	30.5	26.	21.5	....	....	....	....	....	7.5 x 8.2
17137 g	....	31.	....	23.	....	27.2	5.7 x 9	6.4 x 6.8	7 x 8	6.4 x 7.2
17137 h*	81.	34.3	21.5	18.7	39.5	25.	6 x 9.9	6.3 x 8.3	6.6 x 9.8	....
17137 i	....	32.2	....	21.	....	....	5.9 x 8.4	6.7 x 7.2	7.2 x 8.4	6.8 x 8.4
17137 j*	....	34.	....	21.5	....	....	5.5 x 9.4	6.5 x 9.3	6.9 x 10.3	....
17137 k	....	32.5	....	22.3	....	....	5.7 x 8.6	6.8 x 7.1	7.3 x 8.6	6.8 x 8.3
17137 l	....	....	....	20.8	45.6	37.3	....	6.1 x 6.1	6.6 x 8.3	6.6 x 9

* Last molar not above alveolus.

Remarks.—The molar (text Figs. 33, 34, 35) of *Elasmodontomys* appears to be on the peak of rodent specialization. The extreme length of the tooth and the perfection of its mechanical construction demonstrates the high plane of dental development reached by this hystricomorph.

The table of measurements reveals a great amount of individual variation. Variation in the form of the skull is slight throughout most of the

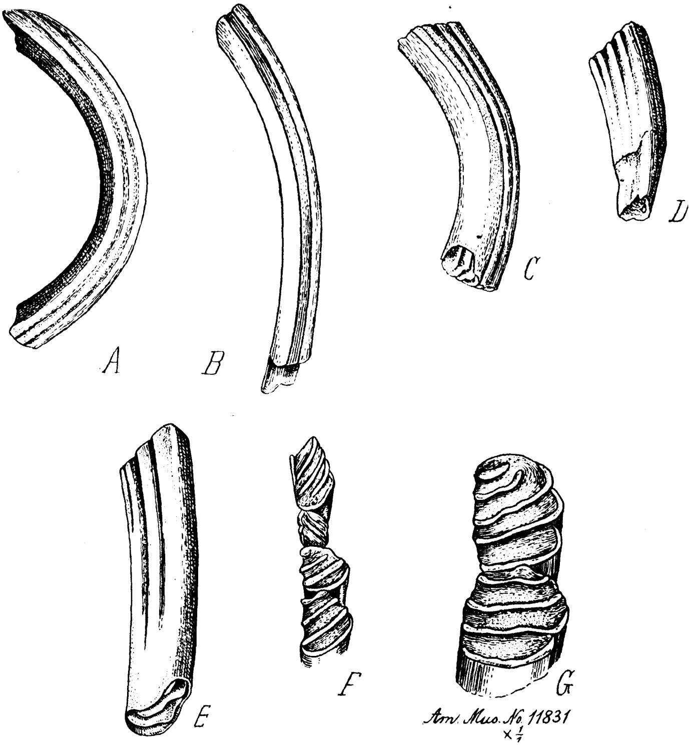

FIG. 35.—*Elasmodontomys obliquus.* Porto Rico. A, oblique aspect of superior incisor; B, oblique anterior aspect of inferior incisor; C, maxillary molar of unworn, maximum length; D, worn maxillary molar of aged animal, showing base of tooth filled in by cement; E, unworn mandibular molar; F, crown view of mandibular molars of aged animal. × 1/1

Amblyrhiza inundata. Island of Anguilla. G, crown view of first two maxillary molars. × 1/1

ries, except for two notable examples, Nos. 17129 and 17132. The first a skull much larger in nearly every dimension and with a decidedly avier rostrum than the others. The second has very unusual dentition, d the difference in form of the skull is the result of this. The denti-n, however, is the most variable feature of the genus and scarcely any two tooth-rows are just alike. The variation in the size of the teeth is great and is well shown by the table of measurements. In addition, there is a remarkable age variation that has been very puzzling until it became possible, through the abundance of material available, to trace the different steps in the growth of the molars.

In the younger animals the molars are very long, from 31–36 mm. in length for the longest maxillary molars, the second and third, and from 36–39 mm. for the longest mandibular molar, the third. In fact, m^2, in two skulls, almost touches the under surface of the frontal, having penetrated the full depth of the skull. In this early stage the laminæ extend the full length of the tooth and the base is open, appearing as a cylindrical shell of enamel about a bundle of parallel plates. Later, as the crown wears, the tooth pushes up from the base to keep a constant height above the alveolar border, and cement is deposited about the base. At the immediate base there is a slight constriction in the enveloping enamel, and when cement is added the base is still further constricted. The alveolus closes and shortens with the wear of the enamel, and in advanced age the cement reaches the plane of wear. At this stage the crown has a homogeneous structure, with perhaps a small hole down the center, and the teeth are weak and brittle. Most of the teeth in this condition are broken off at the border of the alveolus. At first, only 4 laminæ show at the basal end of the maxillary molar, and as there are 6 laminæ appearing in the crown, the extra two are developed from the anterior and posterior walls of the basal enveloping cylinder of enamel. The cross-section of the normal tooth is approximately constant at all stages of wear except possibly in very young animals, where the crowns are constricted when they break through the alveolar border. Several specimens with the third molar only slightly worn show this tooth with a crown smaller than the cross-section at a third of its length. In very old animals the crown surface is much reduced when the cement enters the wearing plane. The teeth shorten progressively, the premolar, as might be expected, wearing out first, followed in rotation by the molars. The greatest amount of wear in the upper series apparently must come upon the second and third molars, as these teeth are so much the longest. The third molar appears to be rather aberrant in its relation to the molar series. Normally a tooth of large size and great length, it is also found in different stages of apparent reduction to the point of disappearance. No. 17132 lacks the last upper molar and, as on one side the bone is broken away next to the second molar, it would be possible to see the third molar even if it were greatly underdeveloped. In connection with the lack of m^3, the other three molars are greatly enlarged, being the largest of the entire series of specimens. The unusual size of the roots of these particular molars has expanded the side of the maxilla and restricted the infraorbital foramen so that it is considerably smaller than in the other specimens. Yet this specimen has a youthful appearance, and this fact, in conjunction with the reduction or lack of development of the third upper molar shown by other specimens, restrains me from describing as a new genus a specimen that undoubtedly would be so described should it be found unassociated in a series. This specimen is interesting as a possible example of the evolution of a new form through discontinuous variation.

The mandibular teeth vary in a similar manner. In some specimens the last molar is just breaking through the jaw, and doubtless in these cases the tooth would, with age, assume the full normal size. It is rather unusual with the hystricomorphs, more especially those with unrooted molars, for the last molar to be so long in reaching a functional stage. With animals like *Hydrochoerus* and *Capromys,* the last molar, both above and below, is functional at a much younger period.

Skeleton of *Elasmodontomys*

The skeleton of *Elasmodontomys* is similar, in some respects, to that of *Dinomys*.[9] The length of each particular bone is greater in *Dinomys,* as may be noted in the tables of measurements, but in special instances the elements are more robust in *Elasmodontomys,* as, for example, the femur. The ratio of length of tibia to length of femur is of the same order; that is, the tibia is shorter than the femur in both cases, but more so in *Elasmodontomys.* The calcaneum is much shorter in *Elasmodontomys* and proportionally broader. The bones of the fore limb are shorter in the Porto Rican rodent.

The ilium of *Dinomys* is considerably heavier and stronger than in *Elasmodontomys,* but the ilium of the latter genus is wider distally.

No perfect scapulæ (text Fig. 36) were collected, but the aggregation of fragmentary specimens show that the glenoid cavity is large and the coracoid process strong and well developed; the constriction at the neck is slight and the body of the scapula is of good thickness, especially along the borders. The spine is strong, but not very extensive; it reaches its greatest depth about midway and then passes into a long acromion. The acromion is a strong process, rod-like in shape, without metacromion, terminal bifurcation or conspicuous expansion. The infraspinous fossa is deep, producing a marked convexity on the inner aspect of the blade and throwing into relief as a concavity the superior half of the inner aspect. (See Plate XXX.)

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[9] No skeletal material of *Dinomys* was available at the time that the skeleton of *Elasmodontomys* was described, in 1918, but since then the American Museum has received a complete specimen of *Dinomys* which died at the New York Zoölogical Park. Unfortunately, the effects of a long captivity are shown in the dentition, but the skeleton appears to be little affected.

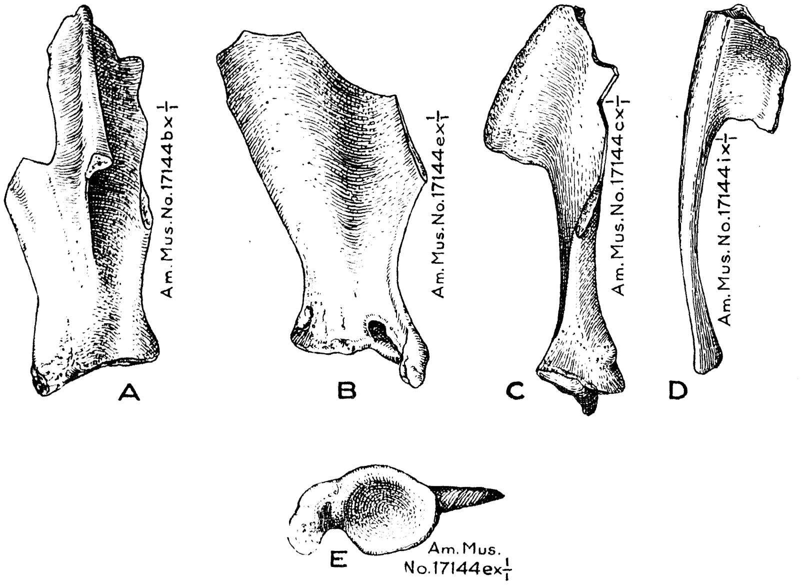

Am. Mus. No. 17144 bx 1/1
A
Am. Mus. No. 17144 ex 1/1
B
Am. Mus. No. 17144 cx 1/1
C
Am. Mus. No. 17144 ix 1/1
D
E
Am. Mus. No. 17144 ex 1/1

FIG. 36. *Elasmodontomys obliquus.* Porto Rico. A, external aspect of left scapula; B, internal aspect; C, posterior aspect; D, spine of scapula; E, glenoid surface of left scapula. × 1/1

Scapulæ collected.—30 fragmentary bones, mostly the articulating extremity, but a few acromion processes are included in the series; no part of the extreme distal border is present.

Measurements of Scapula of Elasmodontomys obliquus

	Breadth of head	Length of head + coracoid	Breadth of neck	Length of free acromion along under side
Elasmodontomys obliquus				
17144 a	10.7	19.2	14.9	....
17144 b	10.2	18.2	14.3	....
17144 c	10.3	18.0	13.4	....
17144 d	10.6	18.0	14.3	....
17144 e	10.9	18.7	13.2	....
17144 f	11.5	20.7	14.3	....
17144 g	11.0	20.7	15.6	....
17144 h	....	....	....	32.5
17144 i	....	....	....	32.3
17144 j	....	....	....	36.3
Dinomys branickii				
70354	11.0	27.5	16.8	32.0
Myopotamus coypu				
1994, U. S. N. M.	10.1	16.7	11.7	35.0
Erethizon dorsatus				
15673	9.9	19.5	....	17.6

The clavicle (text Fig. 37) is a strong, well-developed bone, curved at the proximal end and expanded distally into a trumpet-shaped termination. The shaft approximates a circle in cross-section. (See Plate XXX.)

Clavicles collected.—1, right, in perfect preservation.

Measurements of Clavicle of Elasmodontomys obliquus

	Greatest length	Transverse breadth proximally	Greatest breadth distally	Greatest breadth midway
Elasmodontomys obliquus				
17145	41.6	5.4	7.1	4.4
Dinomys branickii				
70354	50.0	9.0	8.6	5.4
Myopotamus coypu				
1994, U. S. N. M.	44.8	6.6	7.3	4.1
Erethizon dorsatus				
15673	40.3	6.6	7.4	3.7

Only one element of the sternal series has been found, the presternum or manubrium. Anteriorly it is somewhat expanded into a subrectangular plate with a low, median keel on the anterior half and shallow, lateral concavities for the insertion of the first costal cartilages. The

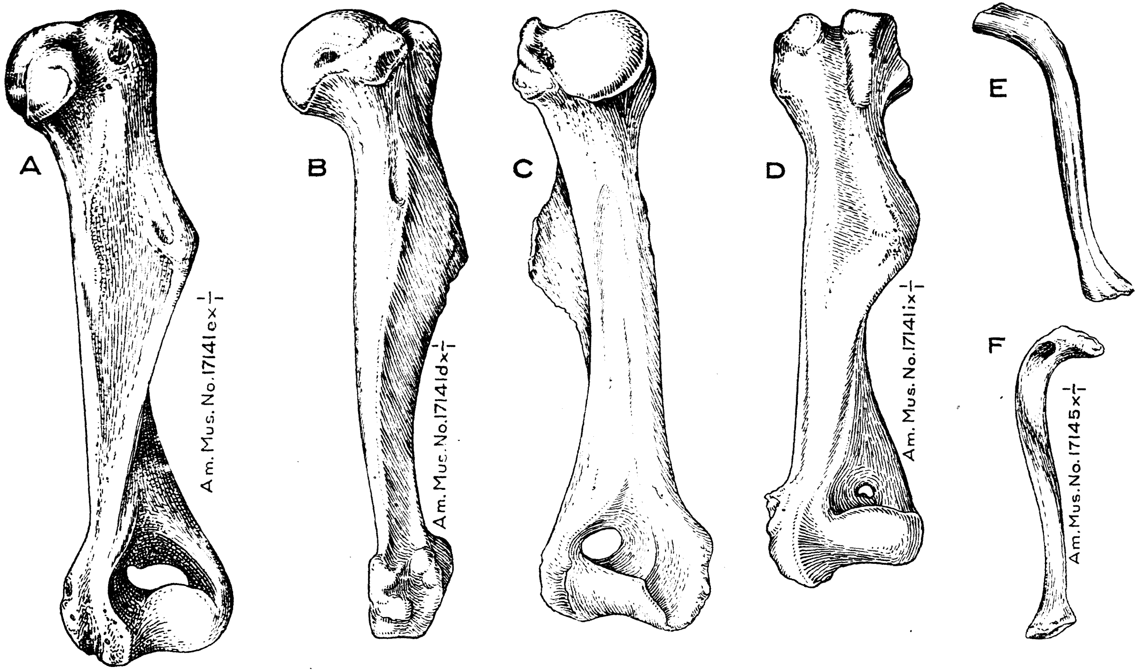

A
Am. Mus. No. 17141 ex 1/1
B
Am. Mus. No. 17141 d x 1/1
C
D
Am. Mus. No. 17141 i x 1/1
E
F
Am. Mus. No. 17145 x 1/1

FIG. 37.—*Elasmodontomys obliquus*. Porto Rico. A, anterior aspect of left humerus; B, internal aspect; C, posterior aspect; D, anterior aspect; E, anterior aspect of left clavicle; F, posterior aspect. × 1/1

posterior half deepens into a roughly trihedral facet for the next sternebra.

Sternebræ collected.—1, a presternum.

Measurements.—Greatest length, 27.2 mm.; greatest breadth, 15.3; breadth at posterior facet, 9.8.

The humerus (text Fig. 37) is short and somewhat heavy. The head is well rounded and of good size, the deltoid crest well developed, the shaft practically straight, and the supratrochlear foramen may or may not be present. The expansion of the condylar termination is very moderate.

Humeri collected.—45, of which more than half are perfect or nearly so, and a number of fragments.

Measurements of Humerus of Elasmodontomys obliquus

	Greatest length	Breadth across head from bicipital groove	Depth through deltoid ridge	Breadth across condyles
Elasmodontomys obliquus				
17141 a	88.6	16.1	18.5	21.0
17141 b	83.8	15.4	17.0	20.5
17141 c	83.8	14.4	15.1	20.7
17141 d	85.4	16.3	17.8	24.0
17141 e	88.8	16.4	17.0	22.6
17141 f	86.0	15.6	16.4	20.8
17141 g	83.2	16.4	18.9	21.0
17141 h	88.2	15.7	17.8	21.2
17141 i	75.9	14.5	15.4	20.8
17141 j	....	18.0	19.6	....
Dinomys branickii				
70354	109.0	19.0	19.0	27.0
Myopotamus coypu				
1994, U. S. N. M	75.3	14.5	18.4	19.8
Erethizon dorsatus				
15673	87.7	17.2	15.0	25.0

The ulna (text Fig. 38) is strong, robust and of good length in proportion to the humerus. The olecranon process is large and very strong; the sigmoid cavity is large and deep; the coronoid process is very high, and below it is a small, deep, longitudinal fossa for the extensor ossis metacarpi pollicis; the distal articulating surfaces are well developed and the shaft is slightly curved, the convexity facing outward.

Ulnæ collected.—About 30, in varying degrees of preservation, a few completely preserved, others lacking only the distal epiphysis; also a number of broken ends and fragments.

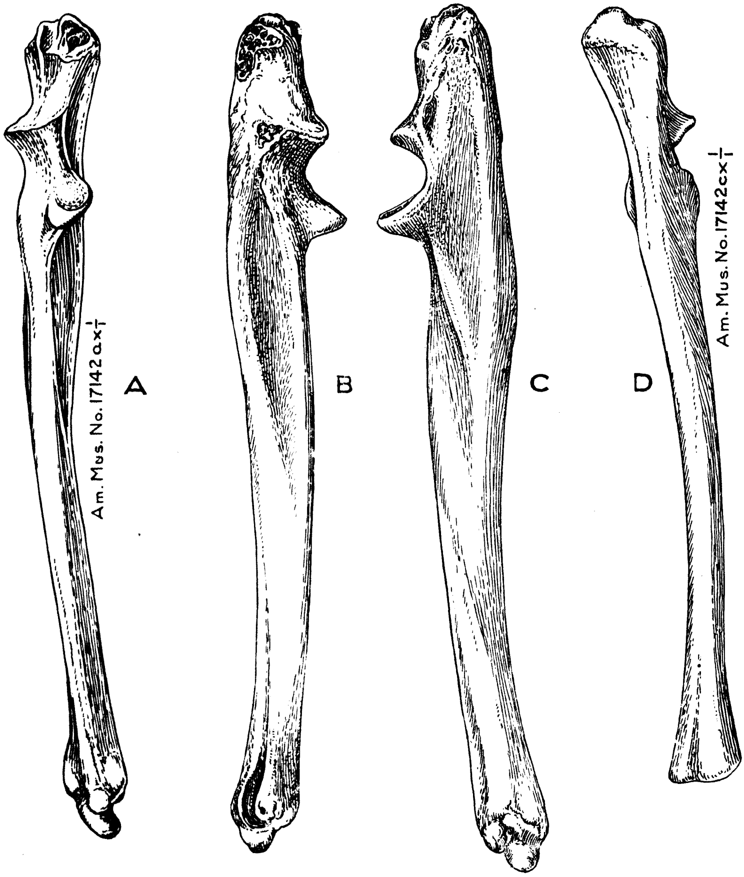


Fig. 38.—*Elasmodontomys obliquus*. Porto Rico. A, anterior aspect of right ulna; B, external aspect; C, internal aspect; D, posterior aspect. × 1/1

Measurements of Ulna of Elasmodontomys obliquus

	Greatest length	Length of olecranon from border of sigmoid cavity	Cross-section of shaft midway
Elasmodontomys obliquus			
17142 a	109.7	19.0	4.8 x 8.0
17142 b	99.4	17.7	4.7 x 6.9
17142 c	100.8*	19.9	5.3 x 8.6
17142 d	97.8*	19.5	5.5 x 9.1
17142 e	....	20.0	5.2 x 8.3
17142 f	99.0*	18.3	4.7 x 8.4
17142 g	....	20.7	5.5 x 7.8
17142 h	....	21.0	5.4 x 8.7
Dinomys branickii			
70354	123.0	23.0	4.8 x 10.6
Myopotamus coypu			
1994, U. S. N. M.	104.0	17.0	4.3 x 7.7
Erethizon dorsatus			
15673	106.7	9.3	4.7 x 6.6

* Lacking the distal epiphysis.

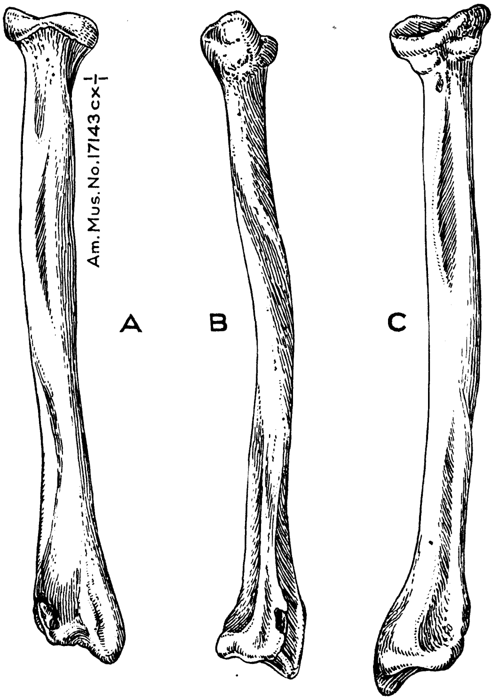


Fig. 39.—*Elasmodontomys obliquus.* Porto Rico. A, anterior aspect of right radius; B, external aspect; C, posterior aspect. × 1/1

The radius (text Fig. 39) is similar to the ulna in its proportions, being strong and well developed. The shaft is evenly curved throughout the proximal two-thirds of its length and each termination is expanded into a large, articulating surface, the distal termination being especially heavy and club-like. The tubercle is not present, but in the region it should occupy there is found a deep, tendon insertion fossa. The muscle insertion areas are exceptionally well defined. A large, median, longitudinal fossa in the proximal third of the concave face of the shaft is possibly for attachment of the supinator brevis and perhaps the flexor profundus digitorum; the pronator teres appears to be a strong muscle wrapping about the distal third of the convex face.

Radii collected.—About 30, of which three are complete and many others nearly so; in addition, many uncleaned and unlisted fragments.

Measurements of Radius of Elasmodontomys obliquus

	Greatest length	Dimensions of head	Greatest breadth of distal extremity	Dimensions of shaft midway
Elasmodontomys obliquus				
17143 a	87.7	7.4 x 12.5	10.5	5.2 x 6.2
17143 b	83.7	6.9 x 10.8	10.5	4.2 x 5.7
17143 c	88.0	8.2 x 12.2	11.8	4.3 x 6.8
17143 d	76.9*	7.1 x 11.4	....	5.1 x 7.3
17143 e	....	7.2 x 13.1	....	4.4 x 6.4
17143 f	....	....	10.0	5.2 x 5.9
17143 g	....	....	11.0	4.8 x 6.7
Dinomys branickii				
70354	95.0	8.0 x 13.5	13.5	4.9 x 6.5
Myopotamus coypu				
1994, U. S. N. M.	82.1	7.0 x 9.7	10.0	5.7 x 5.7
Erethizon dorsatus				
15673	90.0	9.6 x 11.9	15.1	4.7 x 7.6

* Lacks distal epiphysis.

The ribs are normal in all respects. The head and tubercle are well developed and the shaft throughout most of the series is not strongly curved. The tubercle is the highest point on the curve, as the shaft does not curve upward beyond the tubercle. Judging from the way the ribs fit the vertebræ, the thorax of *Elasmodontomys* is large and broad and the strength of the ribs would support a thorax of this type. The first rib is especially heavy.

Ribs collected—60, a number of which are complete.

Measurements.—First rib: Total length, 34.3 mm.; breadth across head and tubercle, 12.9; greatest breadth midway of shaft, 5.2. Sixth rib: Total length, 75.3 mm.; breadth across head and tubercle, 14.2; greatest breadth midway of shaft, 3.7.

The sacrum (text Fig. 40) is a strongly fused unit of four vertebræ. Ossification has not only united all the sutures, but has built up a con-

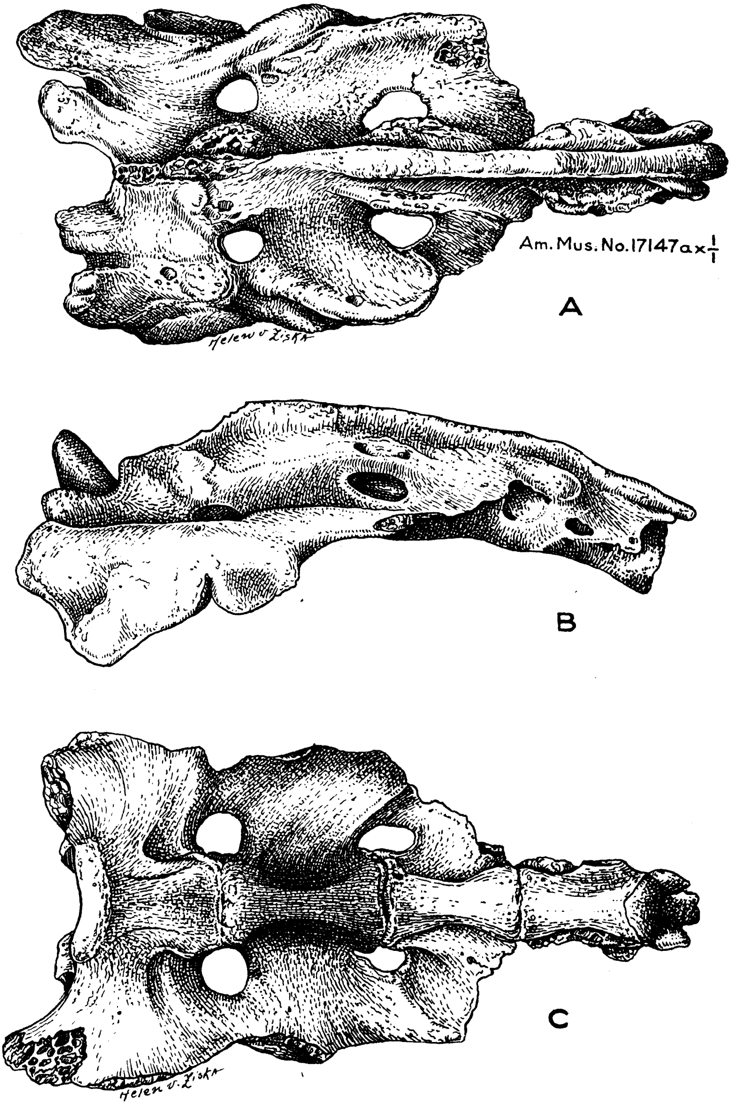


FIG. 40.—*Elasmodontomys obliquus.* Porto Rico. Sacrum. A, dorsal aspect; B, lateral aspect; C, ventral aspect. × 1/1

tinuous dorsal ridge of great strength. The connection of the last vertebra to its fellow has the least advanced ossification. The alæ are strong and heavy, and while well expanded are not much wider than the transverse processes of the posterior vertebræ. The articulating surface for the ilium extends backward onto the second sacral vertebra. The dorsal outline of the sacrum curves evenly downward posteriorly and presents a condition that can be associated only with a very short tail. There is a marked reduction in the centra from the first to the last verterbra. The foramina are all large.

Sacra collected.—22, all rather fragmentary, among which are three that give practically all the characters of the complete sacrum.

Measurements of Sacrum of Elasmodontomys obliquus

	Length of the sacral vertebræ	Greatest breadth across anterior edge of articulation for ilium	Depth through dorsal crest and second vertebra
Elasmodontomys obliquus			
17147 a	72.5	46.3	20.0
17147 b	63.5	....	23.0
17147 c	....	47.5	....
17147 d	....	47.1	....
*Dinomys branickii**			
70354	63.0	54.0	29.0
Myopotamus coypu			
1994, U. S. N. M.	65.0	39.0	25.0
Erethizon dorsatus			
15673	55.0	42.0	25.5

* This part of the *Dinomys* skeleton is articulated and measurements of the innominate are only approximate.

The innominate (text Fig. 41) bone is very long in *Elasmodontomys.* The ilium constitutes about two-thirds of the total length of the innominate and is widely expanded distally. The articulating surface of the ilium is oblique, between the vertical and horizontal planes, and the greater part of the expanded portion forms a broad, shallowly concave shelf adjoining the sacrum. The unexpanded ilium is trihedral in cross-section. The ischium is broad, heavy and curves evenly downward to the pubis. The tuberosity of the ischium is large and the posterior border thickened noticeably in some specimens for tendon attachment. The pubis is not completely represented in any specimen, but appears to be a rather slender element. The pubic symphysis is short and possibly the connection is only ligamentary, to judge from the parts of the pubis preserved. The acetabulum is deep and the cotyloid notch narrow; the obturator foramen is of medium size and oval in shape.

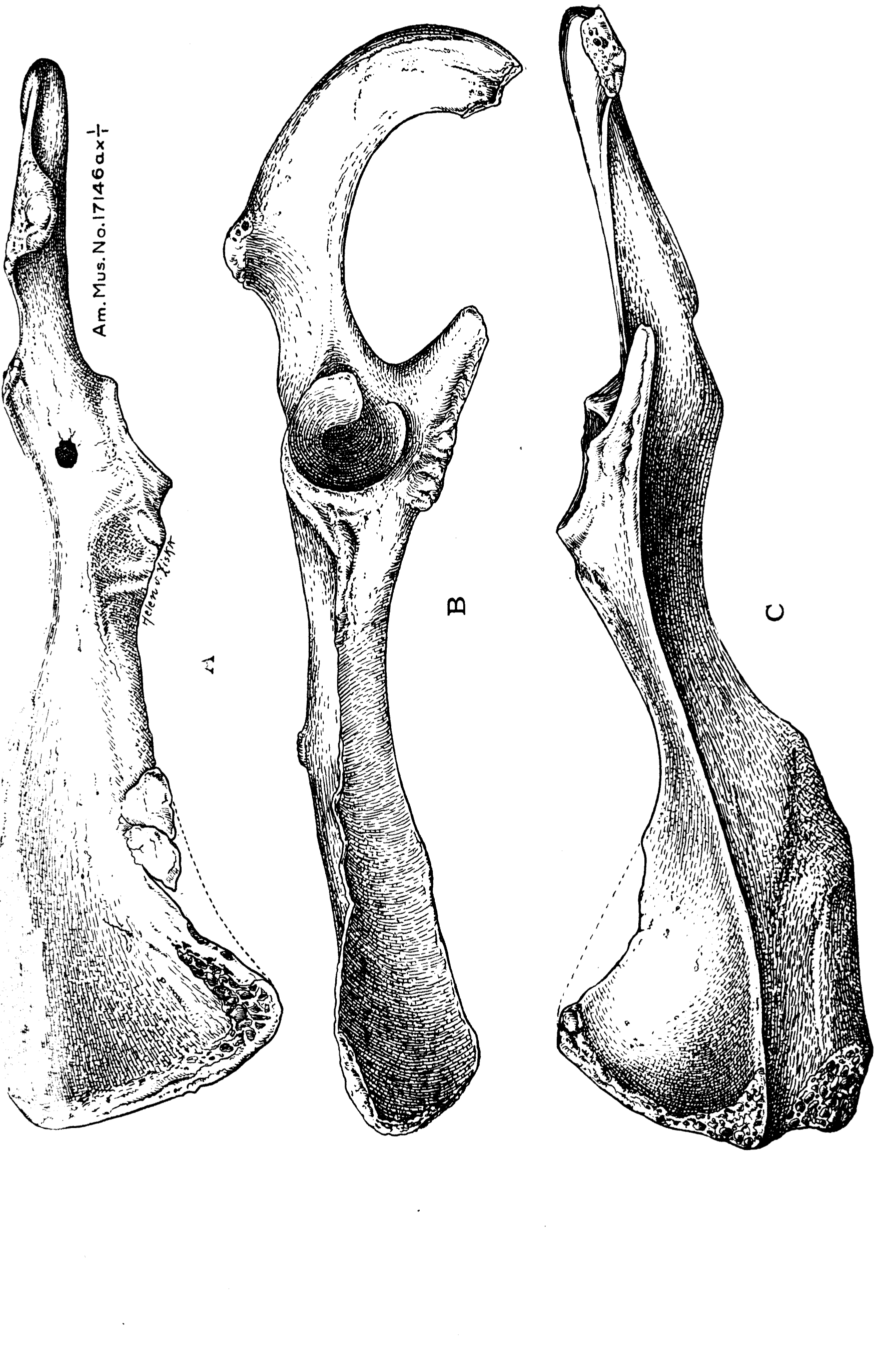


FIG. 41.—*Elasmodontomys obliquus.* Porto Rico. Innominate. A, dorsal aspect: B, lateral aspect: C, ventral aspect. × 1/1

Measurements of Innominate Bone of Elasmodontomys obliquus

	Length of ilium + ischium	Length of ilium from acetabulum	Greatest breadth of ilium	Least breadth of ilium	Length of obturator foramen	Breadth of ischium about midway	Diameter of acetabulum at superior border of cotyloid notch
Elasmodontomys obliquus							
17146 a	149.0	87.0	42.7	13.4	34.3	13.5	15.6
17146 b	...	84.0*	...	14.1	...	...	15.4
17146 c	...	...	...	12.8	...	...	14.7
17146 d	...	75.5	36.2	14.0	...	...	14.5
17146 e	...	79.2	...	15.5	...	15.6	14.2
17146 f	...	75.5*	...	12.3	...	13.2	14.4
17146 g	...	...	...	...	31.9	13.6	14.4
17146 h	...	...	...	...	33.3	13.7	14.8
17146 i	...	...	41.5	...	...	...	...
17146 j	...	...	...	12.9	...	14.2	14.6
Dinomys branickii							
70354	144.0	81.0	26.0	17.0	34.0	13.4	16.0
Myopotamus coypu							
1994, U. S. N. M.	139.3	74.1	17.8	11.1	38.7	15.2	13.0
Erethizon dorsatus							
15673	107.0	58.3	35.0	11.4	32.5	8.3	17.0

* Slightly broken but possible to take measurement approximately correct.

Innominate bones collected.—About 60 good-sized pieces, a very few of which present nearly all the characters, and many additional fragments.

The femur (text Fig. 42) is proportionally robust, the breadth being about one-seventh of the length. The head represents a hemisphere and

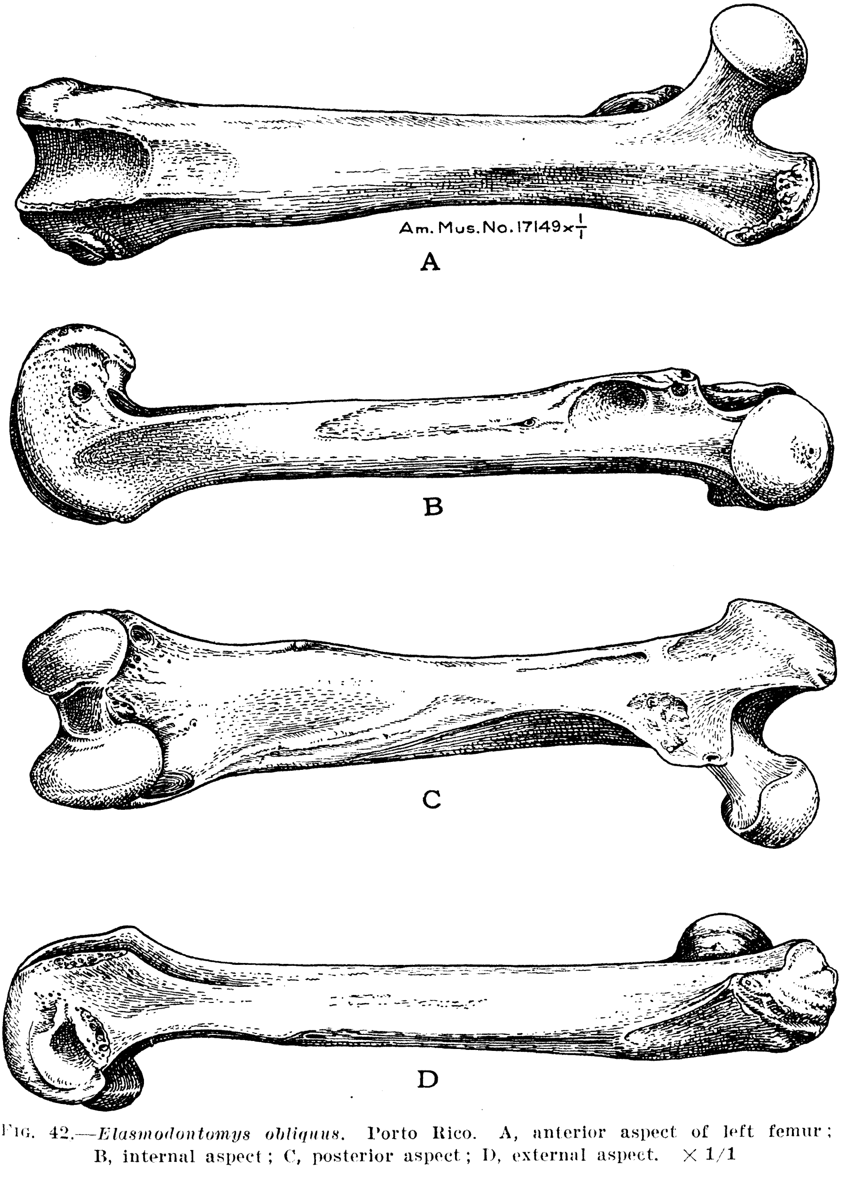


Fig. 42.—*Elasmodontomys obliquus.* Porto Rico. A, anterior aspect of left femur; B, internal aspect; C, posterior aspect; D, external aspect. × 1/1

is sharply marked off by the neck. The greater trochanter is very well developed; the digital fossa is capacious and deep; the lesser trochanter is large and the condylar region normal, with deep trochlear groove. There is a well-developed fossa immediately anterior and distal to the lesser trochanter, evidently for attachment of the pectineus and perhaps one of the adductor muscles. This bone is of the type that forms a powerful, well-muscled hind limb.

Femora collected.—About 60, in good to fair condition; very many are perfectly complete, and there are many broken pieces and much uncleaned material.

Measurements of the Femur of Elasmodontomys obliquus

	Greatest length	Breadth across head to trochanter	Breadth across condyles	Breadth midway of shaft
Elasmodontomys obliquus				
17138 a	105.4	31.2	25.7	14.5
17138 b	98.6	28.0	24.5	13.2
17138 c	111.7	34.8	26.5	14.6
17138 d	102.0	32.2	25.3	13.6
17138 e	108.5	29.1	25.2	14.0
17138 f	105.5	29.5	....	13.6
17138 g	110.0	32.2	26.8	13.3
17138 h	105.5	33.1	26.7	14.0
17138 i	106.8	32.1	26.7	13.2
17138 j	104.7	31.2	23.6	12.1
Dinomys branickii				
70354	130.0	32.0	29.0	12.8
Myopotamus coypu				
1994, U. S. N. M.	96.3	28.8	24.3	12.2
Erethizon dorsatus				
15673	104.7	29.1	23.4	10.7

The tibia (text Fig. 43), in porportion to the femur, is very short. It is in actual length shorter than the femur—a rather unusual condition. It is somewhat straighter than most rodent tibiæ, the external border being only slightly curved, the crest of the anterior border with a prominent tuberosity about midway. The proximal end is widely expanded into the two tuberosities and the distal expansion is normal. The internal malleolus is rather long.

Tibiæ collected.—40, of which the greater part are well preserved, and a number of unlisted fragments.

Measurements of Tibia of Elasmodontomys obliquus

	Greatest length	Breadth across tuberosities	Depth through tuberosity on anterior border
Elasmodontomys obliquus			
17139 a	91.1	25.2	11.8
17139 b	89.8	23.5	12.6
17139 c	91.8	24.0	11.6
17139 d	100.1	26.3	13.5
17139 e	89.7	22.9	10.9
17139 f	89.0	22.8	11.0
17139 g	92.9	24.5	12.7
17139 h	89.8	25.6	11.3
17139 i	84.1	23.9	11.0
17139 j	94.0	22.9	11.8
Dinomys branickii			
70354	118.0	28.0	11.7
Myopotamus coypu			
1994, U. S. N. M.	117.0	22.4	11.9
Erethizon dorsatus			
15673	96.0	24.0	10.0

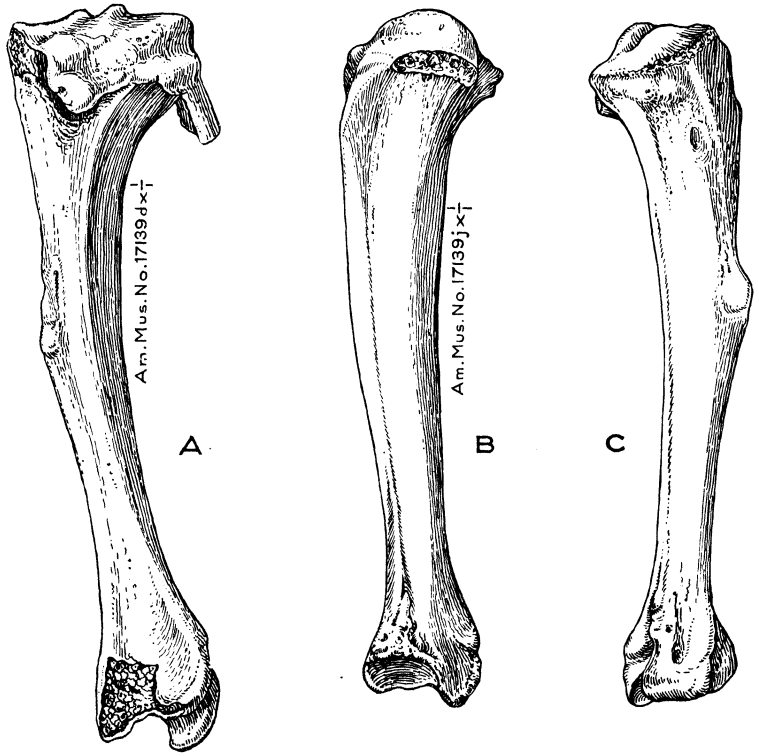


Fig. 43.—*Elasmodontomys obliquus.* Porto Rico. A, anterior aspect of left tibia; B, external aspect; C, internal aspect. × 1/1

In the mature animal the fibula (text Fig. 44) is firmly fused with the tibia proximally, but is apparently always free distally. In young individuals the proximal articulating surface on the tibia for the fibula is well shown. The fibula is a strong, slender element with a broad and fairly thick proximal termination and a heavy, thickened distal end. The shaft is nearly straight, and in young specimens is laterally concave along the internal face, especially proximally; in mature adults the shaft is roughly circular in cross-section.

Fibulæ collected.—2 complete, and proximal ends of several others.

Measurements of Fibula of Elasmodontomys obliquus

	Greatest length	Greatest proximal breadth	Greatest transverse breadth midway
Elasmodontomys obliquus			
17140 a	87.5	17.0	3.7
17140 b	71.8	13.9	5.3
17140 c	....	18.0	4.5
Dinomys branickii			
70354	98.0	14.0	3.5
Myopotamus coypu			
1994, U. S. N. M.	99.5	14.6	4.1
Erethizon dorsatus			
15673	83.8	12.7	3.8

The vertebral series is quite well represented.

Atlas.—The atlas (text Fig. 45) is large and strongly built, with wide, transverse processes, a well-developed tubercle for the longus colli and no pronounced dorsal spine.

Atlases collected.—11, of which 3 are complete.

Axis.—(Text Fig. 45.) This vertebra is conspicuous for the high dorsal spine, only slightly directed backward. The odontoid process is of good size and moderate height.

Axes collected.—14, of which 6 are complete.

Cervicals.—The cervical series is normal in every respect, containing five vertebræ, exclusive of the atlas and axis. The most noteworthy features are the thick, transverse processes and the poorly developed dorsal spines. The third cervical has a fairly well-developed dorsal spine and the sixth has the customary two branches of the transverse processes. The posterior ventral surface of the centrum of the fourth cervical, and to a lesser degree of the third, is built out to form a faintly indented platform quite different from the median ridge along the centra of the other cervicals. The transverse processes of the third, fourth, fifth and

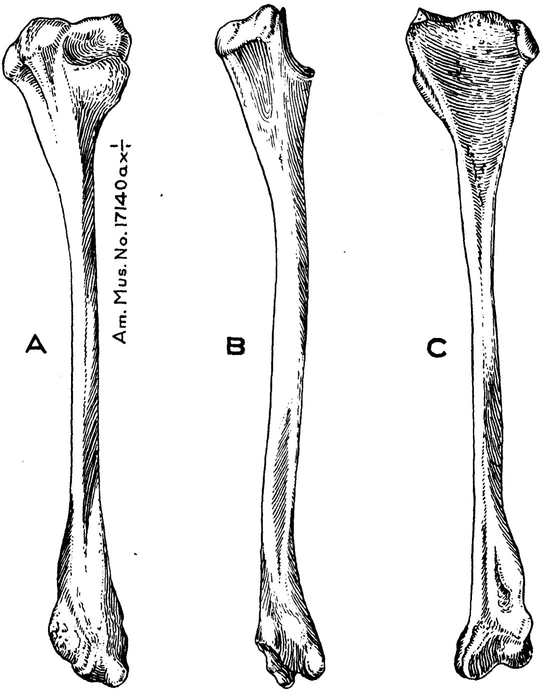
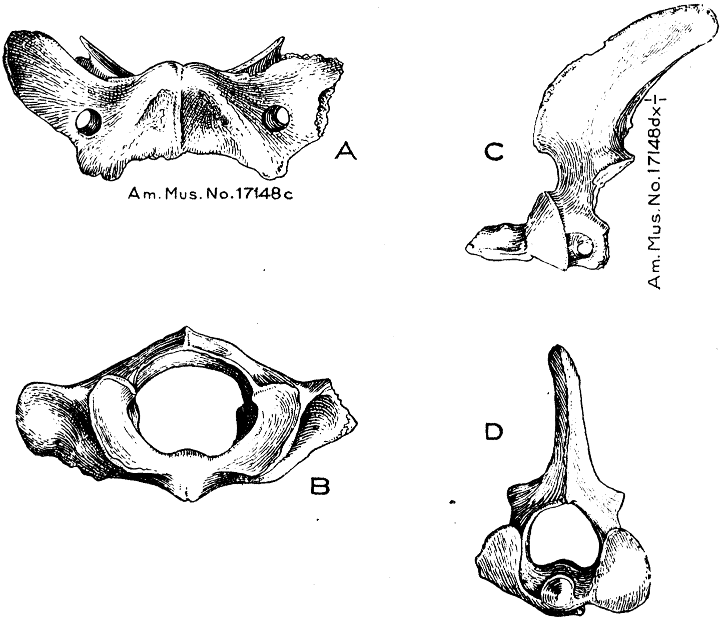


FIG. 44.—*Elasmodontomys obliquus.* Porto Rico. A, external aspect of right fibula; B, posterior aspect; C, internal aspect. × 1/1



IG. 45.—*Elasmodontomys obliquus.* Porto Rico. A, dorsal aspect of atlas; B, anterior aspect; C, lateral aspect of axis; D, anterior aspect. × 1/1

sixth cervicals bear a groove along the anterior face running from the vertebral canal to the tip of the process.

Cervicals collected.—37, most of which are complete. A complete set of five cervicals was found still connected with one another.

Thoracics.—The first thoracic (text Fig. 46) has a very well-developed dorsal spine, which is, however, somewhat slender. The transverse process has an unusually deep concavity for the tubercle of the rib. The second thoracic has a tall, thick dorsal spine expanded at the tip and slightly bifid. A wide range of individual variation is expressed by th series of second thoracic vertebræ. This vertebra has the highest spin of the series, and it is also the thickest from side to side, although surpassed in antero-posterior breadth by some of the vertebræ caudad i the series.

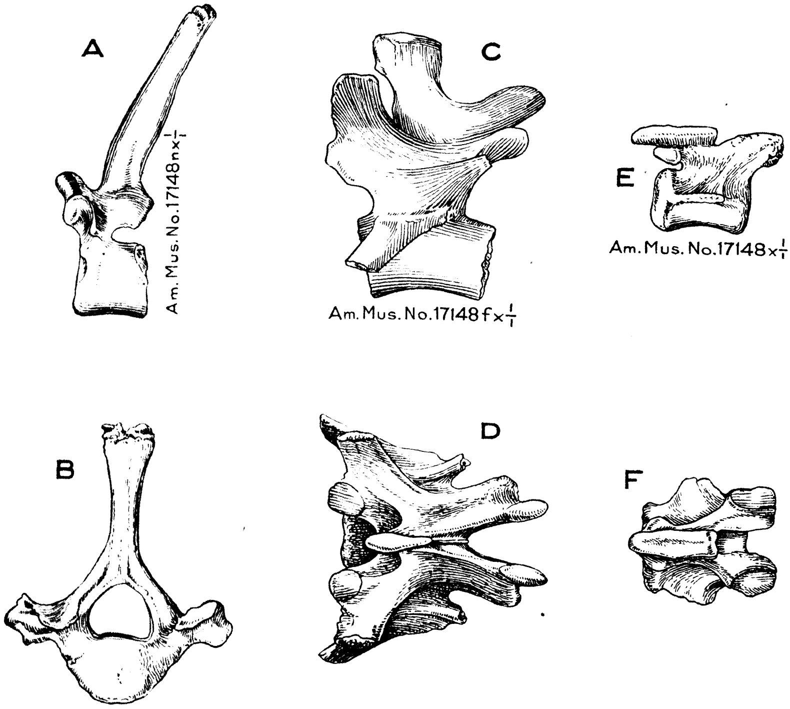


FIG. 46.—*Elasmodontomys obliquus*. Porto Rico. A, lateral aspect of thoracic vertebra; B, anterior aspect; C, lateral aspect of lumbar vertebra; D, dorsal aspect; E, lateral aspect of caudal vertebra; F, dorsal aspect. × 1/1

The remaining thoracics gradually reduce the height of the dors spine, decrease the angle between it and the vertebral axis (so that th actual length appears even less) and widen the spine antero-posteriorly. The concavity for the rib tubercle appears to be deeper at the anterior end of the series. The transverse processes, from about the second vertebra caudad, are curved conspicuously forward, in some vertebræ forming a decided hook. The inter-centra facets for the heads of the ribs are about evenly divided between each pair of adjacent centra.

Thoracics collected.—88, the most of which are complete or nearly so.

Lumbars.—(Text Fig. 46.) The lumbar vertebræ are rather large in proportion to the other vertebræ. The centrum is heavy and the processes short and thick rather than long. The dorsal spine is not very high, but is of good breadth; the mammillary process or metapophysis is short and thick; the transverse process on none of the series is very long, on some it is almost vestigial. There are two sets of accessory processes; the first, in the normal position on the posterior walls of the pedicle, are long and slender; the second, above the posterior articulations and appearing as bifurcations from the dorsal spine, are shorter and thicker.

Measurements of Vertebræ of Elasmodontomys obliquus (from the Vertebræ of Numerous Individuals, Mostly Adults, as far as may be Determined)

		Length of centrum	Vertical depth through dorsal spine and centrum	Breadth across transverse processes
Atlas	17148 a	6.7	21.4	40.5
Atlas	17148 b	5.1	18.8	41.2
Atlas	17148 c	7.2	23.2	46.0
Axis	17148 d	20.7*	35.1	23.0(?)
Axis	17148 e	20.4*	37.0	26.0(?)
Axis	17148 f	22.6*	35.3	....
Third cervical	17148 g	8.8	22.0	....
Third cervical	17148 h	8.8	22.5	27.8
Fifth cervical	17148 i	7.0	18.0	30.9
Fifth cervical	17148 j	8.1	18.8	31.3
Sixth cervical	17148 k	7.6	20.0	31.0
Sixth cervical	17148 l	7.5	18.7	27.8
First thoracic	17148 m	8.0	28.8	29.2
Second thoracic	17148 n	9.2	38.4	29.7
Second thoracic	17148 p	9.3	35.7	25.5
Sixth (?) thoracic	17148 q	8.6	33.0	25.1
Twelfth (?) thoracic	17148 r	10.3	27.5	23.2
First (?) lumbar	17148 s	17.3	31.5	23.1†
Fifth (?) lumbar	17148 t	15.3	35.3	28.3†
First or second Caudal	17148 u	14.0	15.2	29.0
" " "	17148 v	12.4	14.0	....

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* Includes odontoid process.

† Breadth taken across accessory processes, instead of transverse processes.

Lumbars collected.—90, a few of which are perfect and others lack only tips of the processes.

Sacrals.—Described under sacrum.

Caudals.—(Text Fig. 16.) The caudals are reduced in structure and are probably few in number. The transverse processes are broad but short, the dorsal spine is a low, thickened crest; the centrum is not elongate and the anterior zygopophyses are very thick, extending forward from the centrum as a broad V.

Caudals collected.—6.

The tarsus is represented by specimens of the astragulus and calcaneum. The astragulus (text Fig. 17) has a long neck and the articulating surfaces are all normal and well developed. The calcaneum (text Fig. 17) is large and heavy and evidently of the plantigrade type. The external portion has considerable depth and the plantar surface is exceedingly broad, because of the wide expansion of the surface that articulates with the head of the astragulus.

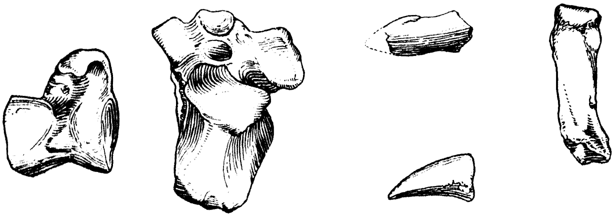

FIG. 17. *Elasmodontomys obliquus.* Porto Rico. Astragulus, calcaneum, two views of ungual phalanx, and metatarsal. × 1/1

Other bones of the tarsal series have not been found.

Astraguli collected.—6.

Calcanea collected.—12.

Measurements.—Astragulus: Greatest length through head, 16.4 mm.; greatest breadth across trochlear surface, 11.7; greatest depth through trochlear region, 9.3.

Calcaneum.—Greatest length, 29.1 mm.; greatest breadth, 10; depth of free portion, 18; extreme depth through articular region, 20.9.

Apparently there is very little difference between the metacarpals and metatarsals (text Fig. 17) of *Elasmodontomys*. The bones considered as metacarpals are slightly shorter and wider than those judged to be metatarsals. This animal seemingly had a generalized manus and pes of five toes each. In proportion to the size of *Elasmodontomys*, these bones are very short. They are not straight, but curve slightly, and the distal articulating surfaces bear a well-developed median keel.

Metacarpals and metatarsals collected.—15.

Measurements.—Metatarsal: Greatest length, 25 mm.; breadth of shaft midway, 1.4; breadth of distal termination, 6.5.

The phalanges (text Fig. 47) are very short and proportionally broad. The articulating surfaces are perfectly smooth, without any median keel; they are concave proximally, convex distally. The ungual phalanx is short, broad and deep, with the termination entire, not bifid.

Phalanges collected.—16, most of them perfect.

Measurements.—Dimensions of a subterminal phalanx, 5.4 mm. broad by 8.2 long; of an ungual phalanx, 4.7 broad by 5.8 deep by 10.8 long.

Relationships of Elasmodontomys

Miller and Gidley (1918, p. 446) in their Synopsis have placed *Elasmodontomys* in the family Dinomyidae, a small group which includes the fossil genera *Amblyrhiza, Megamys* and *Tetrastylus,* among others. This classification is a sound one, and undoubtedly the closest relatives of *Elasmodontomys* are to be found with the Dinomyidae as constituted by these authors.[10]

Dinomys and *Elasmodontomys* are alike in the hypsodont development of the molars and quite similar in the lamellar structure of their cheek teeth. The laminated, hypsodont molar has been independently derived in many groups, and for that reason this type of tooth may or may not be diagnostic of relationship. This highly developed type of molar is seen in *Megamys*, *Amblyrhiza* and *Tetrastylus,* while in slightly modified form it is found in the Jamaican genera, *Clidomys, Spirodontomys* and *Speoxenus,* in *Drytomomys* and in *Castoroides.* In the last named we have an obvious case of parallelism, but all the other genera, with the possible exception of *Drytomomys,* are probably within the same family.

It may be noted, from a comparison of the measurements of *Dinomys* and *Elasmodontomys* given in the various tables, that the two are quite dissimilar in most characters, notably in the much greater breadth and massiveness of the former.

Measurements of *Myocastor* and *Erethizon* have been included in the tables given throughout the treatment of the *Elasmodontomys* skeleton. These two genera were selected not to imply relationship, but to serve as types for comparison—*Myocastor* as a normal-bodied, semi-aquatic rodent, *Erethizon* as a heavy-bodied terrestrial and semi-arboreal rodent. The agreement in most cases is with *Erethizon* rather than with *Myocastor*, showing that *Elasmodontomys* must have been a heavy-bodied rodent. As to whether it was semi-arboreal, little may be said except that the short phalanges and short, non-curved claws would be poor climbing devices. The indication of a short tail can not be taken as evidence of any particular habitat. Nowhere in the skeleton do there appear to be any pronounced aquatic adaptations.

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[10] The Synopsis appeared after my previous report (Memoirs, American Museum of Natural History) had gone to press. In that report I followed the general classification as given by Palmer, North American Fauna, No. 23, p. 844, 1904, placing *Elasmodontomys* in the Chinchillidae, but reserving for it a separate subfamily. The older grouping of genera under the Chinchillidae is well shown by Miller and Gidley to be unnatural. Furthermore, the American Museum has acquired material of *Dinomys*, so that an opportunity is afforded for a direct comparison between it and *Elasmodontomys*.

Family HEPTAXODONTIDAE

1917. Heptaxodontinae Anthony, Bull. Amer. Mus. Nat. Hist., XXXVII, p. 186, January 29.

1918. Heptaxodontidae Miller and Gidley, Synopsis Supergeneric Groups of Rodents, Journ. Wash. Acad. Sci., VIII (13), p. 447, July 19.

1918. Heptaxodontinae Anthony, Indigenous Land Mammals of Porto Rico, p. 397, October 12.

Heptaxodon Anthony

1917. *Heptaxodon* Anthony, Bull. Amer. Mus. Nat. Hist., XXXVII, p. 183, January 29.

1924. *Heptaxodon* Winge, Pattedyr-Slaegter, II, p. 163.

Type.—*Heptaxodon bidens* Anthony.

A hystricomorph rodent of medium size with highly specialized dentition; molar series reduced to two teeth in each jaw; molars with lamellar, reduplicated structure, seven enamel plates present (at least in anterior molar).

Distribution.—Known only from Porto Rico; fossil.

Heptaxodon bidens Anthony

Text Fig. 48, Plate XXXVI

1917. *Heptaxodon bidens* Anthony, Bull. Amer. Mus. Nat. Hist., XXXVII, p. 183, January 29.

1918. *Heptaxodon bidens* Anthony, Indigenous Land Mamals of Porto Rico, p. 397, October 12.

Type.—No. 17101, Dept. Vert. Pal., Amer. Mus. Nat. Hist. A skull fragment comprising palate, two molars with part of a third, and maxillary roots of zygoma.

Type locality.—Utuado, Porto Rico.

Specimens collected.—The type skull and two broken mandibles, on of which came from the Cueva Clara.

Distribution.—Known only from the Island of Porto Rico. Recorded from Utuado (cave on property of Don Gervacio Toraño), from near Morovis (Cueva Clara), and from Ciales (record of Mus. Comp. Zoöl.).

General characters.—A good-sized rodent with two molars in each jaw, the molar crowns composed of seven laminæ.

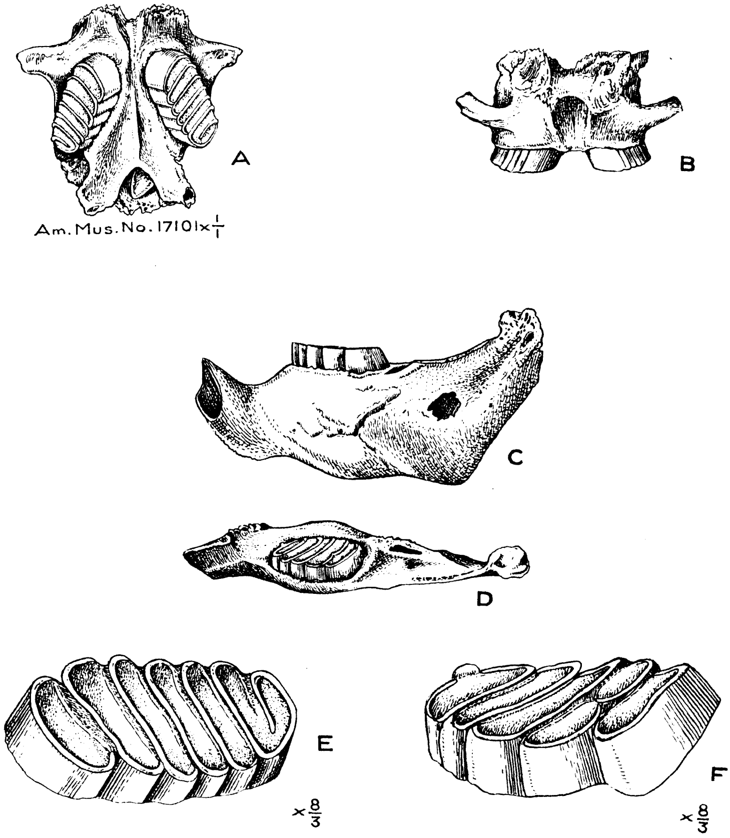

FIG. 48.—*Heptaxodon bidens.* Utuado, Porto Rico. A, B, two views of skull; C, D, two views of mandible. × 1/1. E, crown view of maxillary molar; F, crown view of mandibular molar. × 8/3

Skull.—(Text Fig. 48). Upper part of skull unknown. Palate short, V-shaped, with deep postpalatal notch reaching nearly to plane of posterior borders of first molar teeth; deep median furrow in floor of maxillæ leading down into incisive foramina; maxillary roots of zygoma rather weak; infraorbital foramen probably not very large.

Mandible large and heavy; horizontal ramus deep, posterior ventral border expanded internally and externally.

Dentition.—I, $\frac{1-1}{1-1}$; Pm, $\frac{1-1}{1-1}$; M, $\frac{1-1}{1-1} = 12$. (Text Fig. 48.)

Upper: Incisors unknown; premolar with crown greatly elongated antero-posteriorly and composed of seven parallel plates of enamel separated by dentine, the teeth being inclined outward slightly from each other and toward the rear of the skull; molar not yet functional, but evidently similar to premolar.

Lower: Incisor very weak; premolar similar to upper, but with six main enamel laminæ; these laminæ are so oblique to the tooth-row as to lie almost parallel to its main axis; molar not sufficiently up to be worn, but indicated as similar to premolar.

Measurements.—Breadth of palate at point immediately anterior to zygomatic roots, 13 mm.; length of palate from postpalatal notch to anterior alveolar border, 14 mm.; length of premolar crown, 11.5 mm.; transverse breadth of same tooth, 5.5 mm.; length of mandible from posterior border of incisive alveolus to anterior face of condyle, 38 mm.; depth of ramus + premolar, 16.1 mm., 15.3, and 17; greatest length of premolar (at alveolar plane), 12.5 mm., 11.6 and 12.2; transverse breadth of same tooth, 5 mm., 4.8, and 5.3.

Remarks.—*Heptaxodon* is a very highly specialized type, presenting in the character of its dentition a condition that is found in no other hystricomorph. The reduced dentition, only two molar teeth in each jaw, and the highly developed molar in which the number of laminæ has been increased and the crown elongated, so that in actual space occupied the two molars are equivalent to four, are characters of very considerable importance. The available material is scanty and it is possible that some of the conclusions based upon this material go too far.

In the type skull, the anterior tooth has a well-worn crown surface and the fragment of the skull has the appearance of maturity. However, the second molar tooth lies with its crown below the alveolar border, the assumption being that the tooth was not yet functional, although we must consider as a possibility that its present position in the jaw may be displacement after the death of the animal. The inference that the molar series is comprised of only two teeth seems sound enough when one makes allowance for the size of the individual teeth and the space they occupy in the jaw. The position of the interpterygoid fossa or the postpalatal notch indicates with reasonable certainty about how much of a tooth-row we could expect to find in a perfect skull. The condition of the specimens of mandible leads to a similar line of reasoning, namely, that the second tooth of the molar series, although not up through the mandible is to be the last one of the row. Studying the mechanical features demanded of a rodent dentition, we find that the two molars in each jaw will give ample grinding surface and more would be superfluous. In fact, the late appearance of the second molar tooth, to judge from the specimens, may follow as a result of the mechanical perfection of the first molar tooth, with its seven complete transverse enamel plates, which alone would seem to give sufficient grinding surface for the animal. In some ways this multilamellar molar recalls features seen in the dentition of the capybara and in the elephant, where one tooth by reason of its larger size takes over the major part of the work to be done by the molar dentition.

The upper premolar contains seven distinct and separate parallel laminæ of strong enamel. The evolution of the tooth from a primary pattern of external and internal reëntrants would leave enamel on both the anterior and posterior faces of each transverse loop. This condition is still discernible under a strong magnifying glass, but the anterior enamel plate has greatly thickened, while the posterior has dwindled away to the merest sheet. The dentine that fills in the inter-enamel space, being softer, wears away to form a concavity, and the upstanding transverse plates of enamel act as keen shearing edges. The direction of these plates, oblique to the main axis of the tooth-row, is matched by an obliquity in the lower molars which brings the plates above and below parallel with each other. The lower premolar is constructed on the same scheme as the upper, with the usual reversal that is called for by the lower jaw. The enamel is thickened posteriorly instead of anteriorly, and there are six instead of seven plates. The anterior two plates of the lower premolar, like the posterior two of the upper, are connected by a continuous, partially encircling band of enamel, indicative of the earlier stage through which the other plates passed.

Skeleton of *Heptaxodon bidens*

The only part of the skeleton of this species collected is a tibia, found in the cave where the skull was found. This bone does not agree with tibia of the other rodents and is consequently assumed to belong to *Heptaxodon*.

The tibia is robust and rather short. In most details it resembles the tibia of *Elasmodontomys*, but it is much smaller, the shaft is straighter, the cnemial crest is very poorly developed, and the articulation for the fibula is proportionally narrower. The bone has every appearance of maturity, the epiphyses being firmly fused to the shaft, and its size is such as to match well with the skull of *Heptaxodon*.

Measurements.—Greatest length, 68.5 mm.; dimensions of proximal termination, 12.8 x 16.8; dimensions of distal termination, 7.3 x 10.2; dimensions of shaft at a mid-point, 5 x 5.5.

Relationships of *Heptaxodon*

Miller and Gidley in the Synopsis (1918, p. 447) erected a full family for *Heptaxodon*, the Heptaxodontidae, which stands as a monotypic group, unless *Morenia* from the Miocene of South America should prove to be a member. The available material of *Morenia*, isolated teeth only, is too inadequate to serve as a basis of comparison.

The Heptaxodontidae is founded upon the mechanical dominance of the first tooth of the maxillary series, the reduction in the number of cheek teeth and multilaminar enamel structure, with reduplication in the anterior tooth. In relationships this family approaches the Dinomyidae and Cuniculidae in some characters and is placed next to these groups by Miller and Gidley.

Family ECHIMYIDAE

1918. Echimyidae Miller and Gidley, Supergeneric Groups of Rodents, Journ. Wash. Acad. Sci., VIII (13), p. 445, July 19.

Subfamily ECHIMYINAE

1918. Echimyinae Miller and Gidley, l. c., p. 445.

Isolobodon J. A. Allen

1916. *Isolobodon* J. A. Allen, Ann. New York Acad. Sci., XXVII, p. 19, January 25.
1924. *Isolobodon* Miller, North American Recent Mammals, p. 443.
1924. *Isolobodon* Winge, Pattedyr-Slaegter, II, p. 62.

Type.—*Isolobodon portoricensis* J. A. Allen.

Most like *Plagiodontia* and somewhat like *Capromys;* characterized by molar pattern in which external and internal reëntrants are simple and only slightly oblique to the long axis of crown; molars finely ridged transversely.

Distribution.—Known only from Porto Rico, Santo Domingo, St. Thomas, and St. Croix; fossil.

Isolobodon portoricensis Allen

Text Figs. 49–52, Plates XXVII–XXXIII

1916. *Isolobodon portoricensis* J. A. Allen, Ann. New York Acad. Sci., XXVII, p. 19, Pls. I–V, January 25.

1916. *Isolobodon portoricensis* Miller, Smithsonian Misc. Coll., LXVI (12), p. 4, December 7.

1918. *Isolobodon portoricensis* Anthony, Indigenous Land Mammals of Porto Rico, p. 400, October 12.

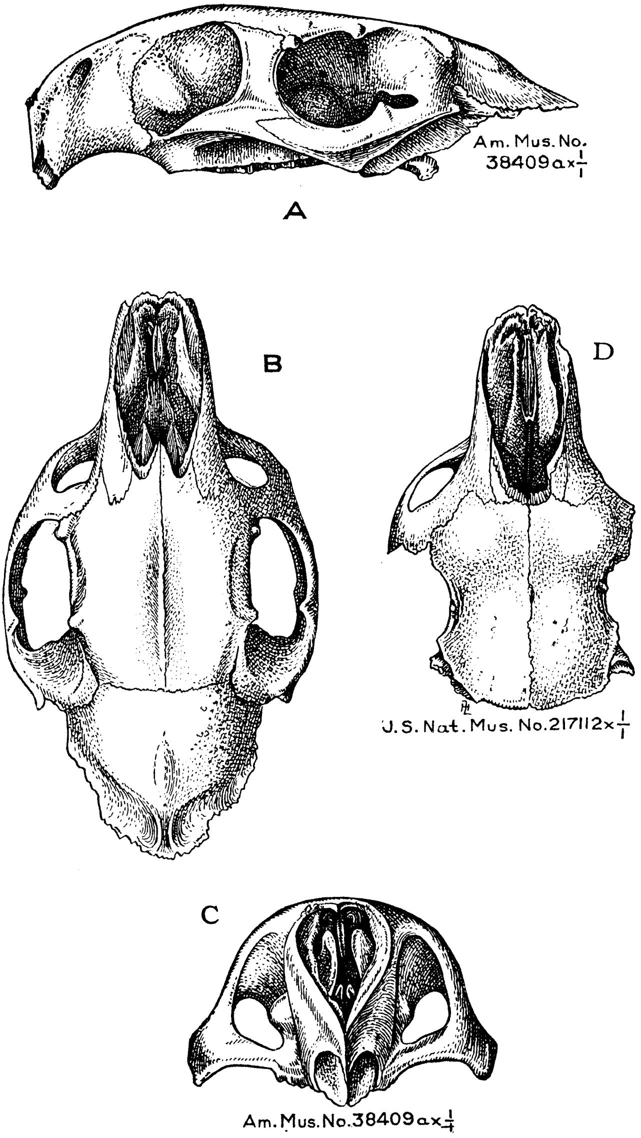

Fig. 49.—*Isolobodon portoricensis*. Utuado, Porto Rico. A, B. C, three views of skull. *Plagiodontia ædium*. San Lorenzo, Santo Domingo. D, view of skull. × 1/1

1918. *Isolobodon portoricensis* Miller, Proc. U. S. Nat. Mus., LIV, p. 507, October 15.

1922. *Isolobodon portoricensis* Miller, Smithsonian Misc. Coll., LXXIV (3), p. 3, October 16.

1924. *Isolobodon portoricensis* Miller, North American Recent Mammals, p. 443.

Type.—No. 38409a, Dept. of Mammals, Amer. Mus. Nat. Hist. Represented by a skull in comparatively good condition, lacking the nasals and basioccipital region and with only two teeth (molars) present.

Type locality.—Cueva de la Ceiba, near Utuado, Porto Rico.

Distribution.—Porto Rico, Santo Domingo, St. Thomas, and St. Croix.

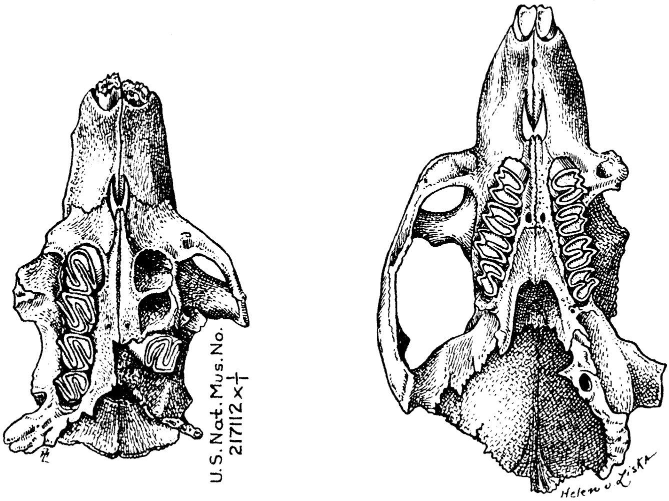
U.S. Nat. Mus. No. 217112 x 1/1
Helen D. Liska

FIG. 50.—A, *Plagiodontia ædium.* San Lorenzo, Santo Domingo. B, *Isolobodon portoricensis.* Utuado, Porto Rico. × 1/1

Recorded in Porto Rico from Utuado, Cabo Rojo (American Museum); specimens in the Museum of Comparative Zoölogy from Ciales, Salinas, San German and Manati.

General characters.—A large rodent about the size of *Capromys melanura*, closely related to *Plagiodontia ædium* F. Cuvier and also to *Capromys.*

Skull.—(Text Figs. 19, 50.) Typically hystricomorph in character: rostrum of moderate length, deeper than broad, nasals arched from side to side, only slightly curved downward from frontal plane, ascending portion of premaxillæ and nasals terminating in about the same plane: frontals wide and almost flat, making a broad, interorbital region with scarcely any constriction, well-developed postorbital processes on frontals;

small, narrow lachrymal projecting above orbit as a rounded process; parietals at first a gently convex continuation of frontal surface, then abruptly compressed and depressed, so that the higher portion of parietal surface is a broad V in shape; interparietals indistinguishable; a low lambdoidal crest and thin median vertical crest on supraoccipital.

Superior outline of skull a gently curving line; depth of skull proportionally very shallow; zygomatic arch heavy; horizontal portion of maxillary root strong, with flattened ventral face, ascending portion wide; jugal wide, with broad ventral angle and terminating above in square-cut shoulder on ventral face of posterior zygomatic root to form part of glenoid; a low, rounded, postorbital process on zygomatic arch; infraorbital foramen large and insertion area of the muscle that passes through it (branch of masseter) well marked on maxillary; root of incisor producing a large swelling on lateral face of maxillary.

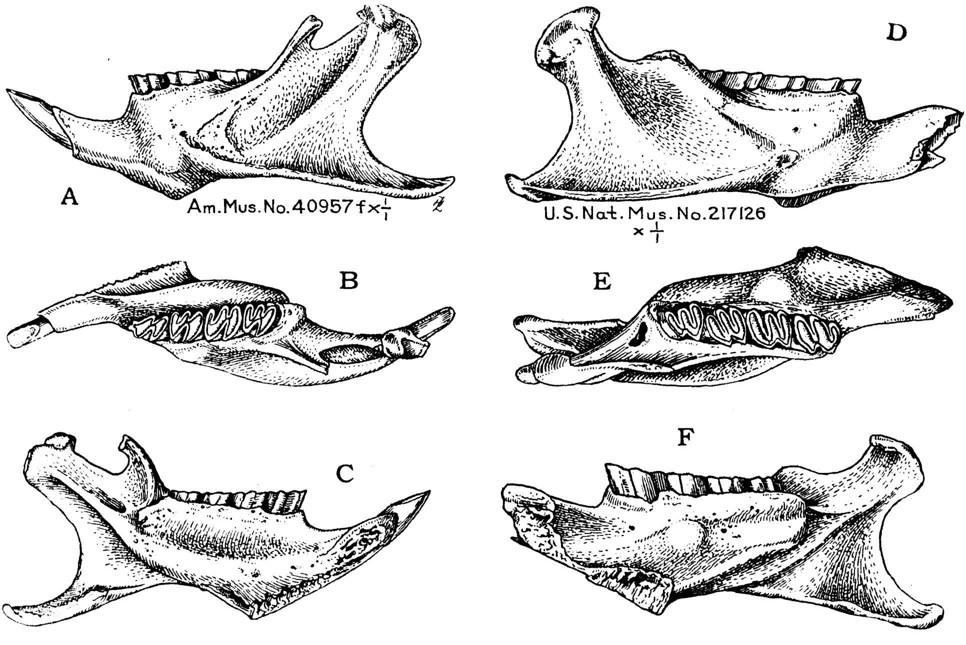

FIG. 51.—*Isolobodon portoricensis.* Utuado, Porto Rico. A, B, C, three views of left mandible. *Plagiodontia aedium.* San Pedro de Macoris, Santo Domingo. D, E, F, three views of mandible. × 1/1

Palate of moderate length, greatly constricted between premolars, widening posteriorly; incisive foramina large, with palatal groove entering from between tooth-rows; interpterygoid notch U-shaped with small median spine and extending almost to anterior border of m^3; interpterygoid processes low; pterygoid fossae deep; basioccipital region missing in specimens and consequently unknown; bulla medium-sized, rounded, nearly as broad as long.

Mandible (text Fig. 51) large and strong; rami diverging broadly from symphysis; horizontal ramus deep, with well-developed ventral margin and greatly prolonged angular process; symphysis long; ascending ramus narrow, rising at an angle of about 45° with molar plane; coronoid very slender and proportionally high, almost reaching plane of condyle; condyle with well rounded and expanded surface; attachment areas for masseter, temporal and pterygoid muscles well developed.

Dentition.—$\mathrm{I}, \frac{1\text{-}1}{1\text{-}1}$; $\mathrm{Pm}, \frac{1\text{-}1}{1\text{-}1}$; $\mathrm{M}, \frac{3\text{-}3}{3\text{-}3} = 20$. (Text Figs. 50, 51, 52.)

Teeth unrooted, with persistent pulp.

Upper: Incisors simple, ungrooved, rather weak; premolar with simple crown pattern, an internal reëntrant angle, which meets an external reëntrant, the inner somewhat deeper than the outer, and an additional smaller external reëntrant, the enamel covered by cement with numerous fine, parallel ridges transverse to the long axis of the tooth; molars similar to premolar, but with only one reëntrant from either side dividing tooth into halves, the plane of these divisions inclined forward from right angles to axis of tooth-row.

Lower: Similar to upper; incisors weak; premolar with one main reëntrant from external and internal sides, small anterior external reëntrant and small anterior internal projecting spur; molars with one deep external and two shallower internal reëntrants; cement on enamel of lower molar series finely ridged, as on upper molars.

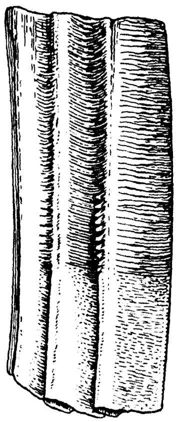

FIG. 52.—*Isolobodon portoricensis.* Utuado, Porto Rico. Lateral view of molar tooth to show striations in cement. × 6/1

Skulls collected.—17 more or less complete skulls, of which 10 are in fair condition, and many fragments of broken skulls.

Mandibles collected.—200, the greater number of which are nearly complete, and unlisted fragments.

Measurements of Skull and Mandible of Isolobodon portoricensis

Skull Catalogue number, Department of Mammals	Greatest length, supraoccipitals to tip of premaxillae	Zygomatic breadth	Least interorbital breadth	Greatest length of frontals along mid-line	Breadth of rostrum at premaxillary suture	Length of nasals	Depth of rostrum at premaxillary suture	Length of palate, postpalatal notch to incisive alveoli	Length of diastema	Alveolar length of maxillary molar series	Mandible Catalogue number, Department of Mammals	Greatest length of mandible, exclusive of incisor	Alveolar length of mandibular molar series
Isolobodon portoricensis													
38409 a*	....	40.0	23.5	30.0	14.0	....	15.7†	32.0	15.0	19.3	38409 d	53.8	18.0
38409 b	....	....	....	25.0	14.5	....	15.3†	31.0	15.0	18.2	40957 f	54.5	18.4
38409 c	....	....	21.5	25.4	13.0	24.8	17.0	29.8	14.4	17.2	40957 g	54.8	19.2
40957 a	71.2	....	....	22.0	13.7	....	14.7†	30.3	14.8	17.6	40957 h	55.0	18.3
40957 b	....	42.5	21.4	25.2	14.2	26.5	18.3	31.7	14.5	19.2	40957 i	....	17.6
40957 c	....	....	20.3	23.7	13.3	....	14.5†	31.0	15.0	18.0	40957 j	....	17.6
40957 d	....	....	19.8	23.2	13.2	....	15.3†	31.7	14.5	18.5	40957 k	56.2	19.1
40957 e	....	....	21.9	24.5	....	....	....	32.0	15.0	18.0	40957 l	56.0	17.9
											40957 m	52.8	19.2
											40957 n	54.2	18.8
Plagiodontia aedium											217,126, U.S.N.M.	62.4	23.7
217,112, U. S. N. M.	....	....	19.0	26.5	13.3	....	16.0†	36.0	17.3	21.0	200,412, U.S.N.M.	....	20.3

* Type.

† Nasals lacking.

Remarks.—*Isolobodon* finds its closet relative in F. Cuvier's *Plagiodontia*, type locality Santo Domingo, from which it differs as follows: *Plagiodontia* has noticeably heavier dentition and the molar crowns above, while containing the same elements as those of *Isolobodon*, have them arranged differently, the reëntrants of *Plagiodontia* being much more oblique to the tooth-row axis and the external reëntrant passing by the internal instead of meeting it squarely, as in *Isolobodon;* the molars of *Plagiodontia* show none of the peculiar transverse ridging of cement on their enamel. *Plagiodontia* lacks the conspicuous swelling on the maxillary caused by the root of the incisor; the incisive foramina are more pinched together posteriorly than in *Isolobodon;* the mandible of *Plagiodontia* is decidedly the heavier and stronger; the lower teeth are larger, but the crown patterns are very similar, except that the lingual reëntrants are deeper in *Plagiodontia;* the root of the incisor produces a rounded swelling on the inside of the mandible near the first molar, and the angular process is shorter and much broader than in *Isolobodon*. Probably *Plagiodontia* was a rather larger animal throughout than *Isolobodon*. (See Plate XXIX.)

The teeth of *Isolobodon*, like those of *Capromys* and some other hystricomorphs, undergo very considerable growth from the time they first appear. The full set of molars is present in very young animals and the teeth are exact duplicates of the adult molars except for size. They show wear very early in life, and consequently an immature specimen may very easily pass for a full-grown adult. This is especially so in the case of the mandibula. As the animal grows older the teeth not only maintain their height above the ramus, but increase in cross-section as well. The open base of the tooth, with its persistent pulp, permits this growth to occur.

Skeleton of *Isolobodon portoricensis*

(See Plates XXX–XXXIII)

The scapula is similar to that of *Capromys pilorides*, except that the latter is about 50 per cent larger and proportionally heavier. The body is very wide, the spine is nearly median in position, the acromion process is very long and the coracoid is well developed. The acromion is free from attachment to the blade for a distance equal to about half the length of the scapula.

Measurements.—Greatest length, 44 mm.; greatest breadth, midline of spine to inferior angle, 18; greatest breadth, midline of spine to anterior superior border, 13; length of acromion and free portion of spine, 25.

Material collected.—8 nearly complete scapulæ, 16 fragmentary.

Two bones, incomplete, suspected of being clavicles, proves too inadequate to be described with certitude.

The humerus has a practically straight shaft, a full, nearly spherical head, deep bicipital groove, greatly developed deltoid crest, slightly expanded condylar region, and small, supra-trochlear foramen. The humerus is proportionally stout, but it is surprisingly short for an animal with such a large skull. The deltoid ridge shows a marked posterior deflection of the border.

Humeri collected.—22, of which 5 are nearly complete.

Measurements of Humerus of Isolobodon portoricensis

	Greatest length	Breadth of head from bicipital groove	Breadth across deltoid ridge	Breadth across condylar region
Isolobodon portoricensis				
38409 1	45.7	8.4	9.8	12.0
40962 a	46.7	9.7		12.3
40962 b	43.8	9.0	8.5	11.0
40962 c	50.1	9.2	9.0	14.4
40962 d			9.7	12.9
*Plagiodontia aedium**				
217127	59.3	10.9	11.4	15.2
Capromys pilorides				
41054	63.1	12.8	13.3	18.4
Capromys thorocatus†				
12816	41.7	8.2	8.6	11.4

* Collection of U. S. Nat. Mus.
† Collection of Mus. Comp. Zoöl.

The *Isolobodon* humerus carries out the impression of the size given by the femur, although it is quite short for an animal with a skull the size of *Capromys melanurus*. The measurements will show the greatest difference between the humeri of *Isolobodon*, *Plagiodontia* and *Capromys*, namely, that of size; the details of structure are identical, with the exception of the marked deflection of the deltoid ridge in *Isolobodon*, not to be found in the other genera.

The ulna has a long, gently curving shaft, a heavy olecranon process and a well-developed styloid process. There is a well-defined fossa just below the coronoid process.

Ulnæ collected.—43, most of which are in a fair state of preservation, three of them practically complete.

Measurements of Ulna of Isolobodon portoricensis

	Greatest length	Length of olecranon from border of sigmoid cavity	Greatest antero-posterior depth about midway
Isolobodon portoricensis			
38409 m		10.4	4.7
40963 a	51.7	9.2	4.0
40963 b		9.8	4.8
Capromys pilorides			
41054	72.8	10.8	5.8

The ulna varies considerably in length with the individual in the series collected. It resembles the ulna of *Capromys pilorides* down to minute details.

The radius is proportionally rather robust, with a well-curved shaft, moderately expanded at either end for the articulating surfaces.

Radii collected.—21, of which one is perfect and several lack only the distal epiphysis.

Measurements of Radius of Isolobodon portoricensis

	Greatest length	Greatest length minus distal epiphysis	Greatest transverse breadth of proximal articulation
Isolobodon portoricensis			
38409 n	44.7	41.5	6.5
40964 a		40.7	6.2
40964 b		42.2	6.4
40964 c		39.4	5.9
Capromys pilorides			
41054	57.0	53.0	8.2

The radius of *Isolobodon* is practically a diminutive of the *Capromys* radius, resembling it in every way.

The ribs indicate a compressed and deepened thorax and are perfectly normal. They have well-developed heads and tubercles and the greatest amount of curve is situated proximally. The shafts are of good strength, with a cross-section widely oval rather than flattened.

Ribs collected.—75, a great many of which are complete.

Measurements.—A rib from about the middle of the series is 47.3 mm. long by 2.5 wide at a mid-point; a similar rib of *Capromys pilorides* measures 54.3 by 2.7.

The ribs, while not showing as many characters as the other bones of the skeleton, appear to agree well with the ribs of *Capromys.*

The sacrum presents no peculiarities of specialization and is composed of four vertebræ, the anterior three very firmly ankylosed, the posterior one not completely fused with its neighbor. The alæ are wide, the expanded transverse processes form a continuous lateral sheet, the neural spines are rather low, and the main axis of the sacrum is but slightly curved.

Sacra collected.—Only one; this one, however, in nearly perfect condition, No. 38409 h.

Measurements.—Breadth across alæ, 31.3 mm.; length through centrum, 39; greatest transverse extent at third sacral, 16.7; greatest depth at third sacral, 11.

The sacrum of *Isolobodon* resembles that of *Capromys pilorides* very closely, the greatest differences being the higher neural spines and the slightly larger size of the latter. No sacrum of *Plagiodontia* is available for comparison.

The innominate shows no characters of unusual import. This bone in *Isolobodon* is practically identical with that of *Plagiodontia* and is very closely approximated in living rodents by *Capromys pilorides.* The ilium is widely expanded at the surface for attachment to the sacrum; this surface is bounded externally by a high, sharp crest along the ventral border of the ilium; there is a noticeable tuberosity for the rectus femoris. The ischium is broad and well developed and bears a prominent spine. The pubis apparently is quite variable in breadth, but in most of the specimens is rather more than half as wide as the ischium; it also bears a spine. Ossification at the symphysis apparently does not take place. The acetabulum is large and well cupped; the obturator foramen is roughly oval in outline.

The resemblance, except for the matter of size, between the innominates of *Isolobodon* and a small adult *Capromys pilorides* is very close. The proportions are nearly the same, *Isolobodon* having somewhat the longer, more slender bone.

Innominate bones collected.—66, in varying states of completeness, a few in very good shape, and many fragments.

Measurements of Innominate Bone of Isolobodon portoricensis

	Greatest length of ilium from border of acetabulum	Greatest breadth of ilium	Least transverse breadth of ilium	Breadth of ischium + pubis	Dimensions of obturator foramen
Isolobodon portoricensis					
38409 j........	46.5?	....	7.5	25.5?	10 x 17.3
40958 a.......	48.8	19.0	7.5	....	— x 18.8
40958 b.......	49.2?	....	8.0	28.0	11 x 19.5
40958 c........	49.0?	....	6.9	27.8	11 x 18.0?
40958 d.......	....	....	8.0	24.5	10.3 x 19.2
*Plagiodontia aedium**					
200414.......	....	....	7.6	26.2?	11.8 x—
217127.......	....	....	8.3	29.3	11.8 x—
Capromys pilorides					
41054.........	54.8	20.4	8.3	34.8	13.2 x 24.0

* Collection of U. S. Nat. Mus.

? Bones somewhat broken, but measurement can be taken with considerable degree of accuracy.

The femur of *Isolobodon* is like that of *Capromys* in its short, thick shaft and wide, greater trochanter. The head is almost a hemisphere, the digital fossa is deep and extensive, the greater trochanter is very well developed and rugose, the lesser trochanter is a low tubercle, the posterior and interior aspects are well marked for muscle attachment, the condyles are heavy and the trochlear surface is long and narrow.

Femora collected.—10, a few of which are practically complete, besides unlisted fragments.

Measurements of Femur of Isolobodon portoricensis

	Greatest length	Transverse breadth across greater trochanter and head	Transverse breadth of shaft midway	Transverse breadth across condyles
Isolobodon portoricensis				
38409 i.............	65.3	20.0	8.8	15.2
40959 a.............	60.3	16.2	6.8	14.1
40959 b.............	....	....	8.8	14.5
40959 c.............	....	18.8	7.3	....
*Plagiodontia aedium**				
217113.............	74.1	18.6	6.6	15.7
Capromys pilorides				
41054 young adult...	78.0	23.7	10.0	19.2

* Collection of U. S. Nat. Mus.

It will be noted from the measurements that the femur of *Plagiodontia* is much longer and proportionally more slender than in *Isolobodon.* In this respect the latter genus much more closely resembles *Capromys,* and in view of the close resemblance in other characters between *Isolobodon* and *Plagiodontia,* it is rather surprising to find such a difference in the femora. The range of variation shown by the series of *Isolobodon* femora is quite extensive, the points of greatest variation being the length and thickness of the shaft, doubtless age characters. The smaller bones are apt to be fully as rugose and showing muscle attachment areas as distinctly as the larger, but the adult characters seem to appear at such an early stage that size and incompletely ossified epiphyses are considered to be the only criteria of age.

The tibia is long, slender and with a noticeably bent shaft. The head is well expanded and the different grooves for tendons and areas for muscle attachment are well marked.

Tibiæ collected.—51, in a fair state of preservation, some complete, and many broken fragments.

Measurements of Tibia of Isolobodon portoricensis

	Greatest length	Breadth across tuberosities	Greatest depth from crest through to posterior face
Isolobodon portoricensis			
38409 k	68.2	15.4	6.5
40960 a	70.8	15.0	6.9
40960 b			7.7
40960 c			8.0
*Plagiodontia aedium**			
217113	72.3	16.0	6.4
217127	74.4	16.0	9.0
Capromys pilorides			
41054	78.5	19.0	8.8

* Collection of U. S. Nat. Mus.

The *Isolobodon* tibia is very similar to that of *Plagiodontia,* bearing out, however, somewhat the same difference expressed in the femur, the longer hind leg of *Plagiodontia.* *Capromys pilorides* has a tibia of the same type, but proportionally more robust.

The fibula is a long, very slender bone, terminating proximally in a widely expanded, fan-shaped sheet, and distally in a thickened and grooved knob. A thin, sharp crest extends along the greater part of the internal surface.

Fibulæ collected.—15, of which 4 are nearly complete, lacking only a portion of either termination.

Measurements of Fibula of Isolobodon portoricensis

	Greatest length	Breadth of proximal termination	Greatest breadth of distal termination
Isolobodon portoricensis			
40961 a	58.0	....	5.8
40961 b	....	11.0	....
40961 c	....	....	6.0
Capromys pilorides			
41054	68.7	15.7	8.4

No fibula of *Plagiodontia* is available but a comparison of the *Isolobodon* fibula with the fibula of *Capromys pilorides* shows agreement in all the essentials, the latter animal, however, having a thicker and stronger fibula.

Relationships of *Isolobodon*

Isolobodon is unquestionably one of the *Capromys* group, close resemblances being obvious throughout the skeleton. The relationship seems to be more with the larger species, such as *Capromys pilorides* and *C. melanurus*, than with the smaller, such as *Geocapromys thoracatus*. In point of size *Isolobodon* is intermediate between the two groups coming the closest, in size of the skull, to *C. melanurus*. The Porto Rican animal is also related to *Plagiodontia*. The latter is somewhat larger than *Isolobodon* and appears to be more slenderly proportioned but the two genera have a number of characters in common.

Isolobodon portoricensis gives evidence of being the last mammal to become extinct on Porto Rico. Its bones are found on the surface in many undisturbed caves and are a common find in the shell-heaps along the coast and inland where the Indians were wont to congregate. That it was a common article of diet among them, there is no doubt, as in the shell-heaps and in caves where the bones are mingled with broken pottery and ashes the association is unquestionable. Some of the bones show signs of having been burned. Probably the fact that the Indians fed on *Isolobodon portoricensis* explains its rather wide range, since it may easily have been carried from one island to the other by them, and for this reason it may be difficult to assign to it its true original habitat. If more extended search proves it to have been common on Santo Domingo, this island may be shown to have been the original center of dispersal. It is unlikely that its primitive range included both Santo Domingo and Porto Rico, because no differentiation between specimens from the two places is seen.

Family ECHIMYIDAE

1918. Echimyidae Miller and Gidley, Supergeneric Groups of Rodents, Journ. Wash. Acad. Sci., VIII (13), p. 445, July 19.

Heteropsomys Anthony

1916. *Heteropsomys* Anthony, Ann. New York Acad. Sci., XXVII, p. 202, August 9.
1924. *Heteropsomys* Winge, Pattedyr-Slaegter, II, p. 163.

Type.—*Heteropsomys insulans* Anthony.

A fair-sized hystricomorph rodent, with rather full, rounded braincase, postorbital process on frontal, proportionally small infraorbital foramen, rooted molars with simple crown pattern of reëntrant angles and enclosed enamel lakes, incisive foramina small and opening laterally into a specialized area surrounded by a thin wall of bone, and large foramen magnum.

Distribution.—Known only from Porto Rico; fossil.

Heteropsomys insulans Anthony

Text Figs. 53, 54, Plates XXXIV–XXXVI

1916. *Heteropsomys insulans* Anthony, Ann. New York Acad. Sci., XXVII, p. 202, August 9.
1916. *Heteropsomys insulans* Miller, Smithsonian Misc. Coll., LXVI (12), Pl. 1, and *passim* in text.
1917. *Heteropsomys insulans* Anthony, Bull. Am. Mus. Nat. Hist., XXXVII, p. 187, January 29.
1918. *Heteropsomys insulans* Anthony, Indigenous Land Mammals of Porto Rico, p. 407, October 12.

Type.—No. 14172, Dept. of Vert. Pal., Amer. Mus. Nat. Hist. The type is a skull in a good state of preservation, lacking one incisor and four molars, the nasals, one zygomatic arch and a bulla. A mandible is associated with the cranium and several other bones of the skeleton, as follows: 3 vertebræ, an ulna and a femur.

Type locality.—Near Utuado, Cueva de la Ceiba, Hacienda Jobo, Porto Rico.

Distribution.—Known only from the Island of Porto Rico; found at Utuado and at Morovis.

General characters.—Skull roughly resembling that of *Capromys brownii* in size and appearance.

Skull.—(Text Fig. 53.) Dorsal outline gently curving from tip of nasals to parietal region, then abruptly curving downward; nasals unknown; ascending portion of premaxilla not reaching to nasal termination; lachrymal indicated as large, frontal with well-developed postorbital process, interorbital constriction slight; parietals strongly convex; supra-occipitals with low, sharp, sagittal crest. Zygomatic arch strong

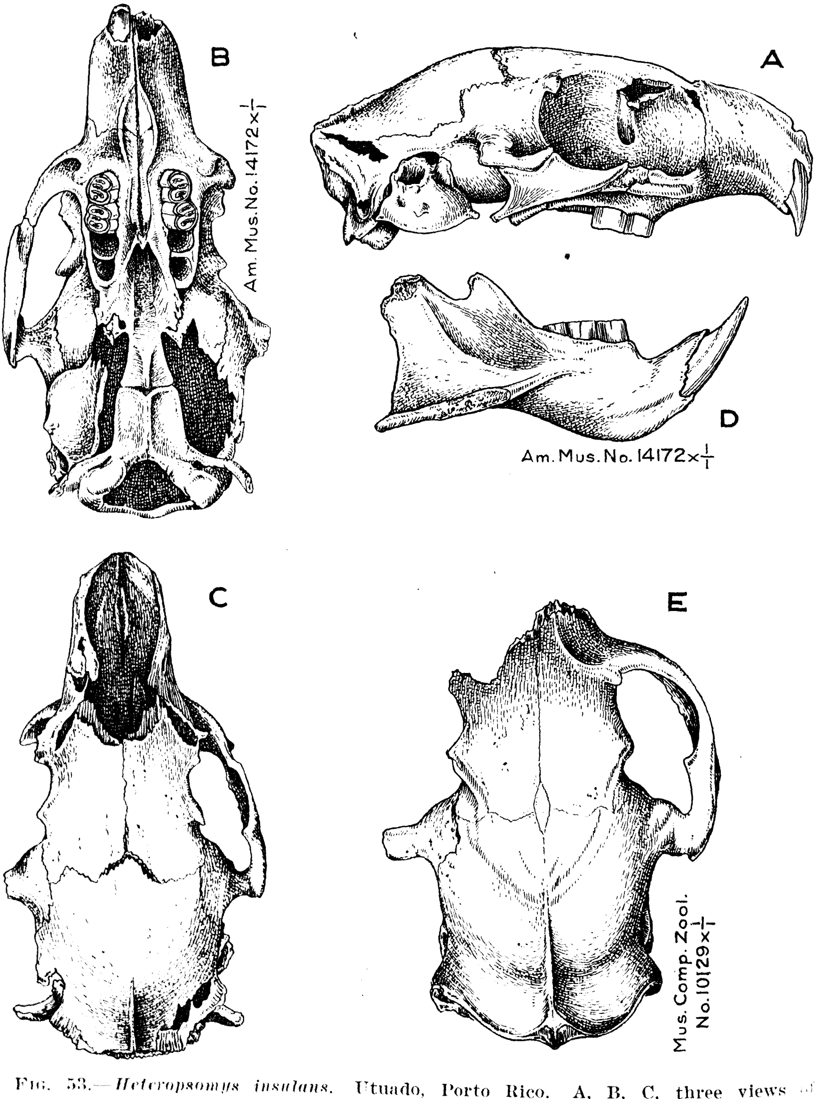

FIG. 53.—*Heteropsomys insulans.* Utuado, Porto Rico. A, B, C, three views of skull; D, view of mandible. × 1/1. *Homopsomys antillensis.* Ciales, Porto Rico. E, view of skull. × 1/1

and heavy; jugal with a prominent posterior process and a low superior postorbital process; zygomatic root of squamosal heavy; mastoid process not developed; infraorbital foramen of medium size. Palate short, parallel-sided, posterior emargination V-shaped, reaching almost to posterior plane of first molar; incisive foramina set in a large median excavation into which they open obliquely from the sides; pterygoid processes fairly strong; bullæ of medium size, slightly compressed; paroccipital processes large; foramen magnum very large.

Mandible of fair size, with well-developed muscle-insertion areas; coronoid low and weak, about as high as condyle; angular process long and slender.

Dentition.—I, $\frac{1-1}{1-1}$ · Pm, $\frac{1-1}{1-1}$ · M, $\frac{3-3}{3-3} = 20$. (Text Fig. 53.)

Upper: Incisors rather weak but very long, the roots being seated at base of anterior zygomatic root, the course of the tooth discernible as a swelling on face of premaxillæ and maxillæ; premolar and molars similar, with a single internal median reëntrant and three enclosed lakes; crowns short, roots short and blunt.

Lower: Similar to upper, with weak incisor and four molar teeth of identical pattern; molar crowns with a shallow, median, external reentrant and two lakes.

Skulls collected.—2, the type and the palatal portion of an immature skull.

Mandibles collected.—1, complete except for m_3 and tip of angular process.

Homopsomys Anthony

1917. ***Homopsomys*** **Anthony, Bull. Amer. Mus. Nat. Hist., XXXVII, p. 187, January 29.**

1924. ***Homopsomys*** **Winge, Pattedyr-Slaegter, II, p. 164.**

Type.—*Homopsomys antillensis* Anthony.

Similar to *Heteropsomys*, but differing in the characters of longer palate, flatter interorbital region and heavier incisors.

Distribution.—Known only from Porto Rico; fossil.

Homopsomys antillensis Anthony

Text Fig. 53, Plates XXXV–XXXVI

1917. ***Homopsomys antillensis*** **Anthony, Bull. Amer. Mus. Nat. Hist., XXXVII, p. 187, January 29.**

1918. ***Homopsomys antillensis*** **Anthony, Indigenous Land Mammals of Porto Rico, p. 408, October 12.**

Measurements of Skull of Heteropsomys insulans

	Length from tip of premaxillæ to lambdoidal crest	Length from anterior border foramen magnum to incisive alveolus	Interorbital breadth	Zygomatic breadth	Breadth of braincase	Breadth of rostrum at maxillary suture	Length of palate, postpalatal notch to incisive alveolus	Breadth of palate inside m¹	Length of diastema	Alveolar length of molar series	Transverse breadth of bulla	Length of mandible from incisive alveolus to anterior border of condyle	Alveolar length of mandibular molar series
14172.... Type	68.8	53.5	18.4	40	26.4	14.8	26	5.2	17.4	14.2	7.2	37.3	15

Measurements of Skull of Homopsomys antillensis

	Zygomatic breadth	Breadth of braincase	Interorbital breadth	Length of palate from postpalatal notch to incisive alveolus	Length of diastema	Alveolar length of maxillary molar series	Breadth of palate inside m¹	Transverse breadth of bulla	Greatest length of mandible	Length of mandible from incisive alveolus to anterior border of condyle	Alveolar length of mandibular molar series
17102........			18.3	30.6	18.6	15?	5.5				
10129*.......	47.4	27.0	20.0			15?		7.6			
10130*.......										41.0	15.0
17102a.......									62.5	40.0	15.2
17102b.......											14.8
17102c.......										40.8	14.8

* Collection of Mus. Comp. Zoöl.

Type.—No. 17102, Dept. Vert. Pal., Amer. Mus. Nat. Hist. The broken anterior half of a skull with no teeth.

Type locality.—Utuado, Porto Rico.

Distribution.—Known only from the Island of Porto Rico. Recorded from the type locality, cave on the property of Don Gervacio Toraño, and from Ciales (record of Mus. Comp. Zoöl.).

General characters.—A good-sized rodent with short-rooted molars, closely related to *Heteropsomys insulans.*

Skull.—(Text Fig. 53.) Very much as in the genus *Heteropsomys.* Nasals unknown; interorbital region flat, postorbital processes well developed; parietals convex; jugal heavy, with posterior ventral process and a short posterior process where jugal meets squamosal; palate parallel-sided, posterior emargination V-shaped, reaching posterior plane of m^2; palate at diastema but slightly concave; zygomatic root of maxilla broad and strong; bulla small; foramen magnum large.

Mandible slightly larger than that of *Heteropsomys;* root of incisor producing a large rounded swelling on external face of ascending ramus.

Dentition.—As far as known, identical with that of *Heteropsomys* except for slightly heavier incisors.

Skulls collected.—1, the type. In addition I have been loaned a skull with a mandible of this species found near Ciales by Dr. G. M. Allen, of the Museum of Comparative Zoölogy.

Mandibles collected.—5, more or less fragmentary; one is perfect except for the loss of three molars.

Remarks.—*Homopsomys* is very closely related to *Heteropsomys.* Indeed, it may be that the two forms should be considered congeneric, and I would make them so but for the fact that the material at hand is rather inadequate. Additional collecting may bring to light more specimens and disclose characters now unknown. To avoid confusion and an unnecessary shifting of names, the status of *Homopsomys* is left unchanged. The differences between the two genera, such as the length of the palate, the noticeable size difference, the incisors heavier in *Homopsomys* than in *Heteropsomys,* and the more convex frontals in the latter genus, are borne out by the skull collected at Ciales and loaned to me by Dr. G. M. Allen, of the Museum of Comparative Zoölogy. These differences are such, however, as may well be included within the limits of a single genus. The amount of variation due to age being unknown for this restricted group, due allowance must be made for such changes, although the differences noted appear to be beyond the ordinary range of age variation. The few parts of the skeletons of these two forms are described without any attempt at distinction, as it is very doubtful if distinction is possible.

A few of the bones were definitely associated with the type skull and are so indicated in the following descriptions.

Skeletons of *Heteropsomys* and *Homopsomys*

Text Fig. 54

On account of the scarcity of material of these two genera, it is not possible at present to go into great detail. The few limb bones collected—femora, innominate, ulna and radius—unfortunately do not give any great insight into the true nature of the animals' skeletons. They do not show any highly specialized characters and agree as well with *Capromys* as with *Dasyprocta* or any other hystricomorph having generalized upper limb bones. The vertebræ, however, agree significantly with those of the Dasyproctidae. Because of a suspected relationship between these two genera and the Dasyproctidae, on the basis of skull characters, additional clues were sought in the skeleton, but the material is too inadequate to permit of conclusive statements. A further difficulty lies in the impossibility of establishing definite associations in a cave fauna, making the identification of unspecialized bones a problem.

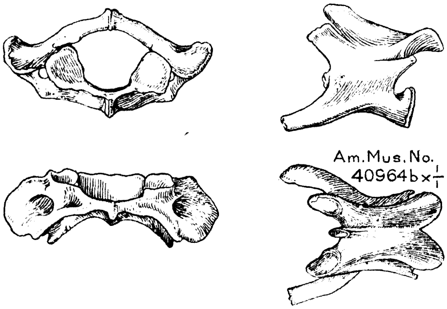

FIG. 54.—*Heteropsomys insulanus.* Utuado, Porto Rico. Two views of atlas and two views of lumbar vertebra. × 1/1

The ulna is about equal in length to the femur. The olecranon process is very strong and widely expanded distally; the sigmoid cavity is exceptionally large; the styloid process is well developed; and the shaft is slightly curved. Muscle attachment areas are conspicuous.

Ulnæ collected.—3, two of which are perfect and appear to be associated with the type skull of *Heteropsomys*.

Measurements.—Greatest length, 67.3 mm.; length of olecranon from sigmoid cavity, 10.3; dimensions of shaft at a mid-point, 3.6 by 5.6.

The radius is well proportioned, with well-developed articulating surfaces. The shaft is but slightly curved and its surface is strongly marked by tendons and muscles.

Radii collected.—1, in perfect condition.

Measurements.—Greatest length, 48 mm.; dimensions of articulating surfaces, proximal, 4.2 by 6.8; distal, 5.7 by 6.6; dimensions of shaft at a mid-point, 2.5 by 3.2.

Two innominate bones provisionally referred to this group are normal in character. The ilium is abruptly expanded along the internal margin and the articulating surface is deeply marked. The ischium and pubis are incomplete, but apparently are unspecialized in any way. The acetabulum is deep.

Innominata collected.—2, both fragmentary.

Measurements.—Transverse breadth of ilium near acetabulum, respectively, 8.5 mm., 9.7; transverse breadth of ilium at expanded portion, 14.2, 13; greatest diameter of acetabulum, 11.3, 10.1.

The femur is a strong bone, rather more slender than in *Capromys pilorides.* The head is full and symmetrical, the trochanters are very well developed, the lesser projecting as a noticeable process from the intertrochanteric ridge, the digital fossa is deep, the condyles are heavy and the third trochanter is faintly indicated on the shaft. The muscle insertion areas on the posterior face of the femur are well marked.

Femora collected.—5, one of which is perfect and is associated with the type skull of *Heteropsomys.* Two femora loaned by the Museum of Comparative Zoölogy are referred to this group; they were collected near Ciales.

*Measurements of Femora of **Heteropsomys insulans** and **Homopsomys antillensis***

	Length, head to condyles	Diameter of head	Transverse breadth of shaft at mid-point	Breadth across condyles
17157 a	71.3	9.3	9.8	16.9
17157 b	68.8	8.5	7.8	15.0
17157 c	68.5	8.2	7.6	14.5
10133*	....	8.5	7.6	....

* Collection of Mus. Comp. Zoöl.

Three vertebræ from the cave where the type skull of *Heteropsomys* was taken are provisionally associated with the type. They are an atlas, a thoracic and a lumbar vertebra.

The atlas (text Fig. 54) is of ample proportions, with broad, strong transverse processes and a well-developed tubercle. The foramina are all large and the two ventral foramina on each side open outward in a common foramen, as in *Dasyprocta*.

Measurements.—Breadth across transverse processes, 27.8 mm.; vertical depth through tubercle, 14.6.

The vertebral series is represented by scanty material.

Thoracic vertebra.—The thoracic is rather small, with a well-developed dorsal spine, strong transverse processes and the posterior zygopophyses high up on the expanded base of the dorsal spine.

Measurements.—Breadth across transverse processes, 14; length of centrum, 5.4.

Lumbar vertebra.—(Text Fig. 54.) The lumbar is of good size with well-developed processes. The mammillary processes are long, but somewhat narrow, the dorsal process is low, the zygopophyses are robust and the accessory processes are short. Agreement with the lumbars of *Dasyprocta* is readily apparent.

Measurements.—Length of centrum, 11.8; vertical depth through dorsal spine, 14.6.

Relationships of *Heteropsomys* and *Homopsomys*

In discussing the relationships of *Heteropsomys* and *Homopsomys* in a previous paper (Anthony, 1917) I pointed out the strong resemblances between these genera and the Dasyproctidae, creating the Heteropsomyinae as a subfamily of Dasyproctidae. Since then, Miller and Gidley's able paper on the Supergeneric Groups of Rodents (1918) has appeared and offers a general classification more in keeping with available material than the looser grouping of earlier workers. Accepting their bases of classification, I have reconsidered the relationships of the Heteropsomyinae and can no longer believe that these two genera are Dasyproctidae.

Miller and Gidley have used in their key for the Hystricoidae the development and importance of the lachrymal bone. In *Heteropsomys* the lachrymal appears to be quite typically of the Echimyidae pattern and so much unlike the lachrymal of the Dasyproctidae as to more than offset the converging characters.

However, while I have included these two genera of Porto Rican fossils in the Echimyidae, I still think that they are rather widely distinct from many of the genera included in Miller and Gidley's Echimyinae, the subfamily where these authors have included *Heteropsomys* and *Homopsomys*. Aside from a general similarity in the structure of the molars, the lachrymal, the bullæ, etc., there are very striking differences between these two genera and any of the spiny rats, such as the large foramen magnum, the well-developed postorbital process on the frontal, the incisive foramina opening into a specialized area and the rounded braincase—characters not seen in *Proechimys, Loncheres* and their allies. A hint of the specialized incisive foramina is seen in the skull of *Loncheres grandis*.

The many resemblances between *Heteropsomys* and *Homopsomys* and the Dasyproctidae are probably best treated as parallelisms.

ORDER EDENTATA

Family MEGALONICHIDAE

1889. Megalonycidae Ameghino, Mam. Fos. Rep. Arg., p. 665.

Acratocnus Anthony

1916. *Acratocnus* Anthony, Ann. New York Acad. Sci., XXVII, p. 195, August 9.

1923. *Acratocnus* Winge, Pattedyr-Slaegter. I, p. 313.

Type.—*Acratocnus odontrigonus* Anthony.

A small ground-sloth related to *Hapalops* of the Santa Cruz and *Megalocnus* of Cuba, and characterized by trigonal canines, large preorbital fossæ, sagittal crest, symphyseal tongue on mandible, small size and light limb bones.

Distribution.—Known only from Porto Rico; fossil.

Acratocnus odontrigonus Anthony

Text Figs. 55, 57, 59, 60, 62, 64–70, 72, 74, 77–84, Plates XXXVII–XLIII, XLVI–LIV

1916. *Acratocnus odontrigonus* Anthony, Ann. New York Acad. Sci., XXVII, p. 195, August 9.

1918. *Acratocnus odontrigonus* Anthony, Indigenous Land Mammals of Porto Rico, p. 412, October 12.

Type.—No. 14170, Dept. Vert. Pal., Amer. Mus. Nat. Hist. The type is the anterior portion of a skull extending to the interorbital region above and to the first alveolus of the molar series below. The right canine is the only tooth present. Three fragments of the mandibular rami are associated with the skull.

Type locality.—Cueva de la Ceiba, Hacienda Jobo, near Utuado, Porto Rico.

Distribution.—Known only from the Island of Porto Rico. Recorded from Utuado, Morovis and Ciales (Ciales is the record of the Museum of Comparative Zoölogy).

Skulls collected.—14, five of which are nearly complete, the other specimens being broken rostral portions. A number of loose teeth and smaller pieces of skull collected undoubtedly are to be associated with these.

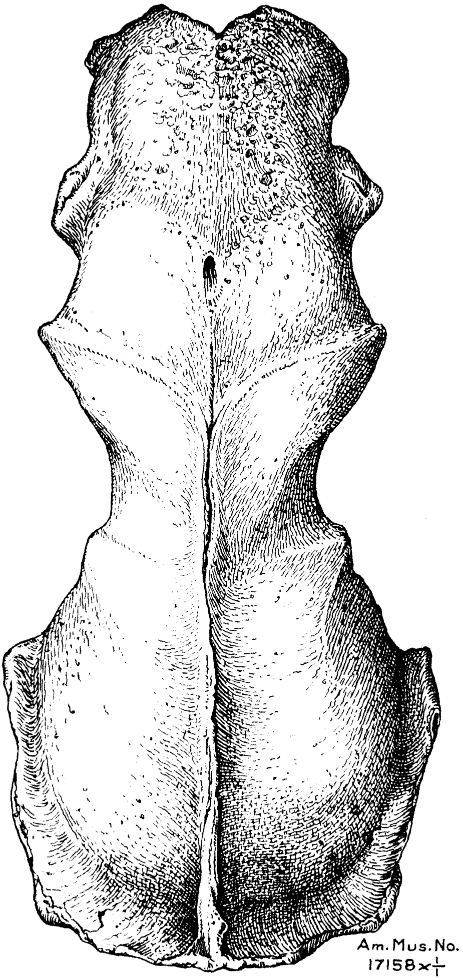

FIG. 55. *Acratocnus odontrigonus.* Utuado, Porto Rico. × 1/1

Mandibles collected.—15 specimens, of which none are perfect, but several have both rami preserved in part and the assemblage gives most of the characters.

General description.—A small ground-sloth related to *Megalocnus* of Cuba, but a much lighter-limbed, smaller animal.

Skull.[11]—(Text Figs. 55, 57, 59, 60, 62, 64.) Rostrum short and very wide, strongly convex from side to side, broader than deep, greatest

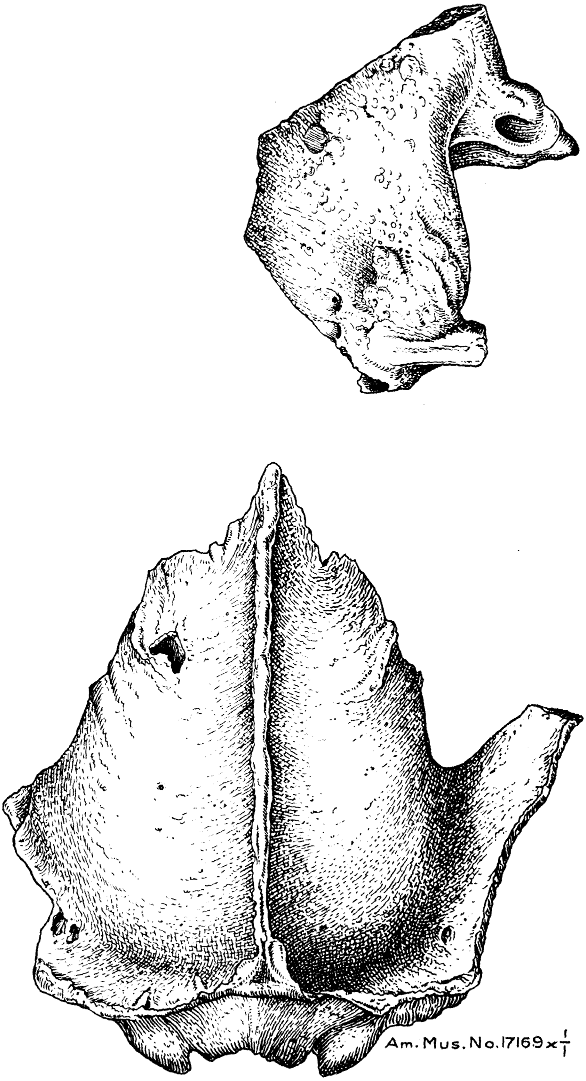

FIG. 56.—*Acratocnus major.* Utuado, Porto Rico. × 1/1

breadth across canines, nasals completely fused with each other and with the maxillæ; frontals broad and slightly convex, with thickened, subterete, postorbital processes; parietals much depressed below frontal plane and with a marked postorbital constriction; a high, strong, sagittal crest from frontals to the high lambdoidal crest.

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[11] The acquisition of additional material has enabled me to add to the original description and to correct impressions which were based upon inadequate specimens.

Superior outline (text Fig. 59) a well-curved line with highest point over parietal region; lachrymal duct with a large, external opening walled about by bone; maxillary with a well-marked articulation for malar; malar (text Fig. 64) a large element with long, high, postorbital process and lacking a posterior articulation with skull; posterior zygomatic root a strong, thick process; ventral outline with palate sloping downward from canines.

Palate parallel-sided throughout region of cheek-teeth, but widening out abruptly to meet the canines in front; a deep, subelliptical constriction from each side in the palate, the preorbital fossa, between the first of the cheek-teeth and the canine; postpalatal notch reaching about to the fourth cheek-teeth; pterygoid region apparently similar to that of *Bradypus;* glenoid broad and open; occipital condyles large and protruding.

Mandible (text Figs. 57, 62) strong and heavy; horizontal ramus deep and nearly straight, with rounded swelling on ventral surface due to root of last tooth of molar series; a small, but well-developed, symphyseal tongue present;[12] ascending ramus broad, with a strong, high condyle greatly expanded transversely and a low, wide coronoid process; angular process broad and rounded.

Dentition.—C, $\frac{1-1}{1-1}$; cheek-teeth, $\frac{4-4}{3-3} = 18$. (Text Figs. 59, 62, 65.)

Upper: Canine heavy and trigonal, strongly curved, with face worn to give sharp, triangular cutting edge; cheek-teeth all similar, with long crowns, open roots and elliptical cross-section, the enamel forming transverse anterior and posterior cutting edges with a concavity between them.

Lower: Canine strong and straight, with flat, internal face, rest of the periphery convex, the cutting edge worn flat and producing a sharp-pointed tooth; molars similar to those of upper series.

Measurements.—See tables, pages 162, 167.

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[12] At the time *Acratocnus odontrigonus* was described (1916) the fragmentary mandibular material available led me to suppose this genus lacked a symphyseal tongue on the mandible—an erroneous conclusion, as disclosed by material acquired later.

Acratocnus major Anthony

Text Figs. 56, 58, 61, 63, 71, 73, 75, 76, 79, 82, Plates XLIV–XLVII, XLIX–L, LII, LIV

1918. *Acratocnus major* Anthony, Indigenous Land Mammals of Porto Rico, p. 412, October 12.

Type.—No. 17169, Dept. Vert. Pal., Amer. Mus. Nat. Hist.; represented by a broken skull and mandible, part of a scapula, fragments of both humeri, both ulnæ in perfect condition, part of a radius, a badly broken pelvic girdle, a broken femur, one tibia nearly perfect and part of the other, end of a fibula, both calcanea, one of them perfect, an astragulus, a number of phalanges from manus and pes, and a number of vertebræ.

The skull represents the posterior parts of the braincase and basicranial region nearly to the posterior nares; a fragment of the frontals and maxillary is present; and the mandible comprises both horizontal rami with all the teeth present, but badly fractured. One upper canine, loose, was collected.

Type locality.—Cave on the property of Don Gervacio Toraño, near Utuado, Porto Rico.

Distribution.—Found only at the type locality.

Specimens collected.—Only the type.

General characters.—Very similar to *Acratocnus odontrigonus* but larger and heavier and with different skull characters.

Skull.—(Text Figs. 56, 58, 61, 63.) Large and very massive; frontals broad, with peg-like postorbital processes; lachrymal and maxillary fused with root of malar;[13] zygomatic root of squamosal very thick and strong and sending back a prominent ridge to the lambdoidal crest; sagittal crest high and thick; glenoid with a broad, longitudinal concavity; basioccipital elevated noticeably above plane of basisphenoid.

Mandible very heavy and strong, with a short but thick symphyseal tongue; very similar in general structure to mandible of *odontrigonus.*

Dentition.—Similar to that of *odontrigonus,* but considerably heavier; upper dentition represented by canine only.

Measurements.—See table of measurements given for *Acratocnus*. page 162.

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[13] Possibly due to advanced age.

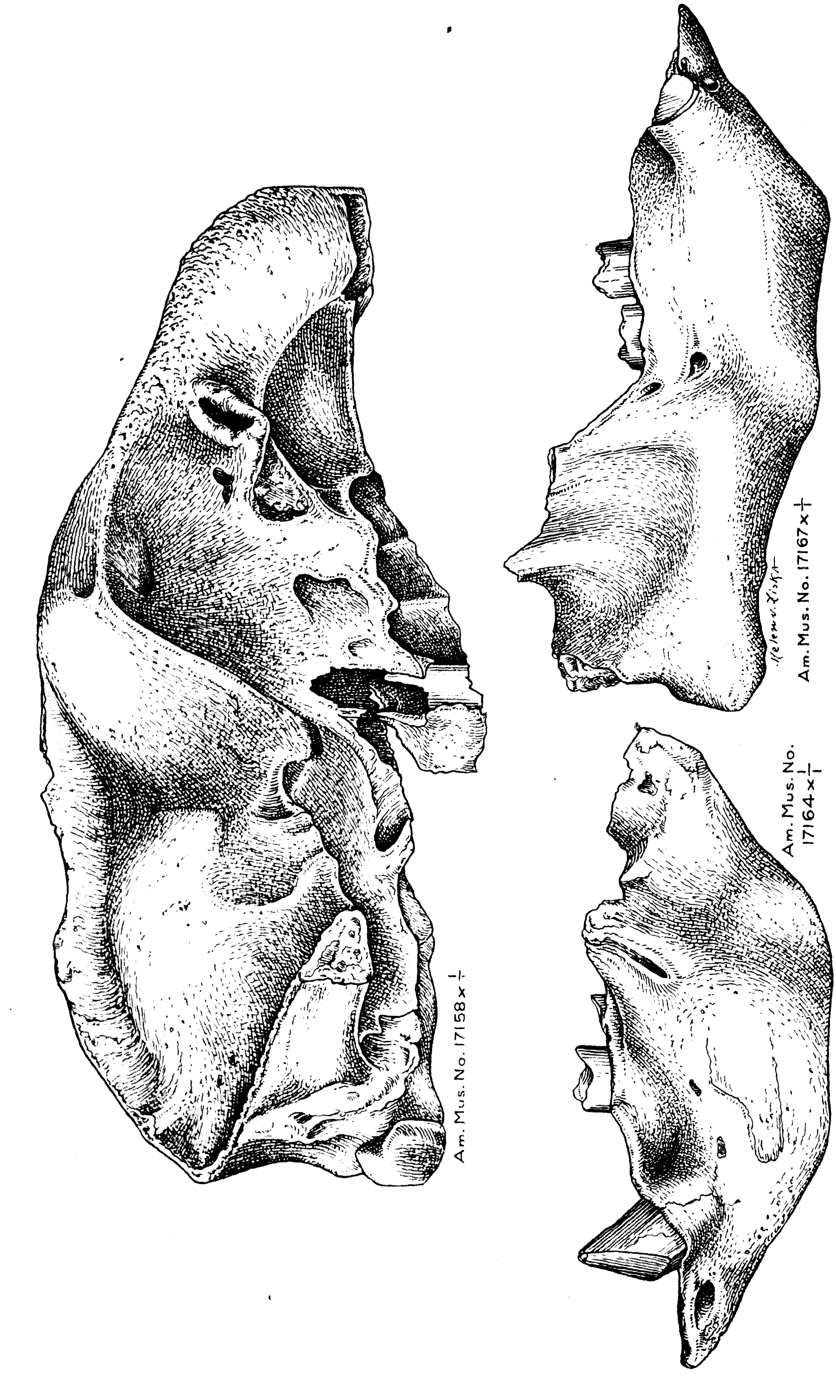

FIG. 57.—*Acratocnus odontrigonus.* Skull and mandibles found near Utuado, Porto Rico. × 1/1

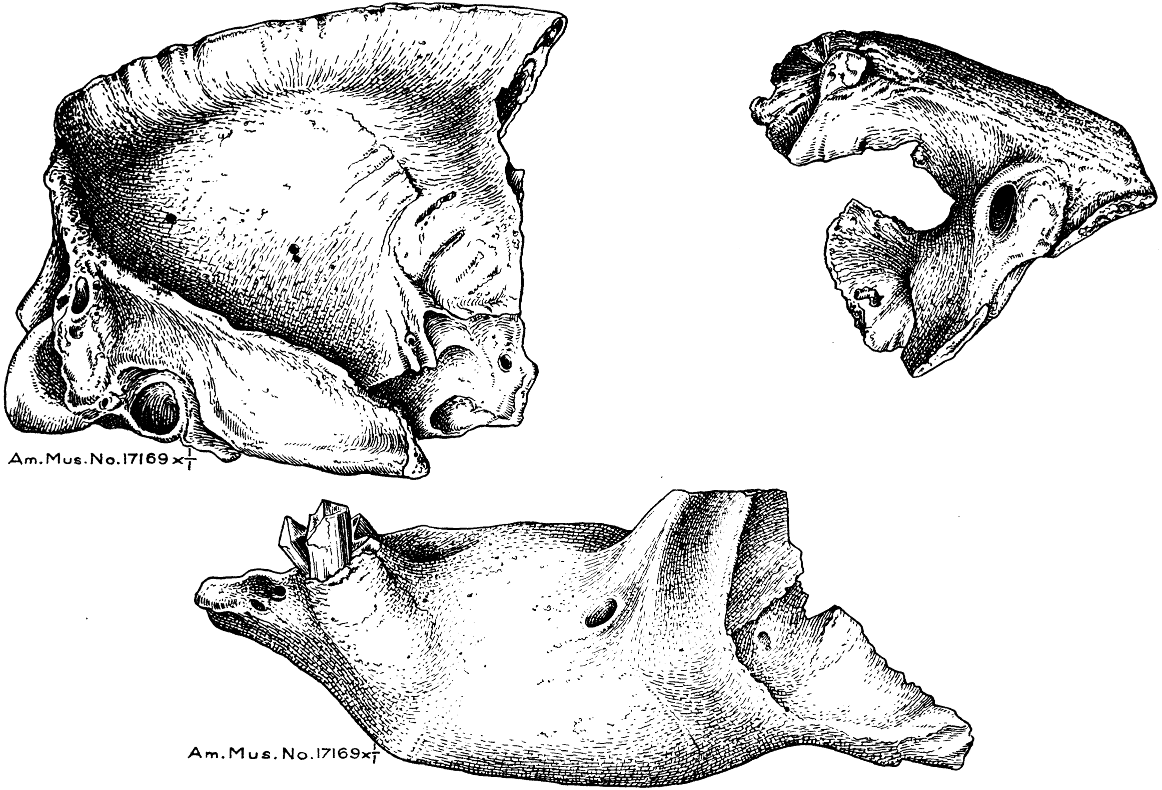

Fig. 58.—*Acratocnus major.* Skull and left mandible found near Utuado, Porto Rico. × 1/1

Measurements of the Skull of Acratocnus

Catalogue number of cranium	Length from tip of rostrum to occipital condyles	Breadth across postorbital processes	Breadth of braincase at postorbital constriction	Breadth of braincase above posterior zygomatic roots	Breadth of rostrum across canines	Breadth of frontals posterior to lachrymal ducts	Length of palate, post-palatal notch to anterior notch	Breadth of palate outside second cheek-tooth	Breadth of palate inside second cheek-tooth	Length of diastema	Least breadth of palate anterior to first cheek-tooth	Depth of skull through sagittal crest and basi-sphenoid	Alveolar length of maxillary molar series	Catalogue number of mandible	Length of mandible from condyle to tip of symphyseal tongue	Depth of horizontal ramus at second tooth of molar series	Breadth of mandible across canines	Length of symphysis	Length of mandibular diastema between canine and first tooth of molar series	Alveolar length of mandibular molar series
Acratocnus odontrigonus																				
14170*......	......	......	......	......	35.0	27.2	......	......	......	23.5	13.4	......	......	17164	......	30.7	37.5	40.5	12.4	29.2
17158......	136.2	47.5	28.5	51	44.5	34.0	58.0	31.0	9.0	25.2	14.2	51.4	35.5	17165	......	24.5	......	......	11.7	25.0
17159......	......	34.6	26.6	......	......	26.5	56.0	30.7	8.5	23.5	12.4	......	32.5	17166	......	28.6	......	38.6	12.5	28.2
17160......	......	......	......	......	......	......	60.0	30.0	7.3	26.0	12.0	......	33.2	17167	......	24.2	......	35.8	12.3	26.0
17161......	......	......	......	......	41.0	33.5	......	......	......	25.5	14.5	......	......	17168†	......	......	......	33.7	10.8	......
17162......	......	......	......	......	41.5	30.0	......	30.3	8.2	26.5	15.8	......	......	17710	......	29.7	......	......	......	28.0?
17163......	......	......	......	......	41.8	28.0	......	......	......	24.7	12.0	......	......	17712	......	31.0	38.4	45.5	6.5?	......
17715......	140.0	47.0?	27.4	46.8	44.6	30.9	65.0	29.0	8.0	27.5	13.3	51.0	33.7	17713	......	28.0	35.5	36.5	10.0	26.8
17720......	137.5	39.0?	21.0	49.0	41.6	28.5	58.0?	31.0	8.0	27.0	12.0	49.0	31.7	17714	......	33.5	......	42.0?	9.0	29.5
17721......	135.0	43.0	29.3	49.6	45.0	31.6	64.0	33.0	9.6	26.0	20.6	49.6	33.6	17717‡	109.6	27.5	36.0	40.5	15.0	27.0
17722......	135.5	47.0	26.0	48.0	40.3	29.6	60.0	30.8	8.4	22.4	12.0	50.0	32.5	17718	......	34.6	44.0	52.0?	12.0?	31.0?
														17719	105.0	32.3	35.0	37.6	12.5	30.4
Acratocnus major																				
17169*......	......	66.0§	......	54.0	......	......	......	......	......	......	......	54.3	......	......	......	36.0	42.6	41.0	17.0	32.0

* Type.

† Juvenile ?

‡ This mandible probably belongs with cranium No. 17720.

§ This measurement was obtained from a fragment representing the frontal region from postorbital process to a point beyond the mid-line.

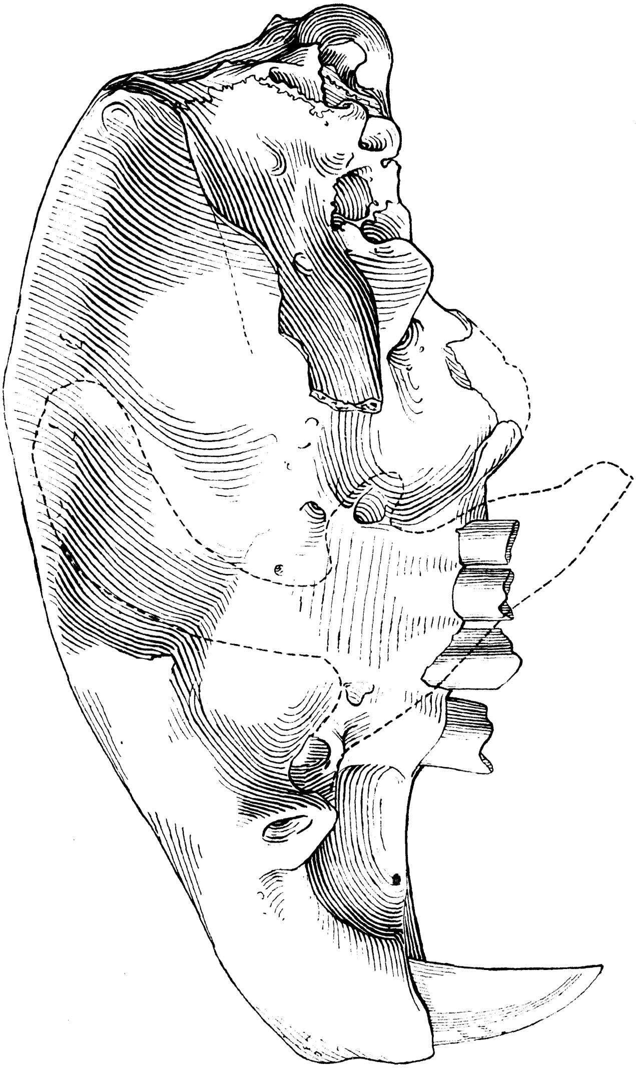

FIG. 59.—*Acratocnus odontrigonus.* Skull, found near Morovis, Porto Rico. × 1/1

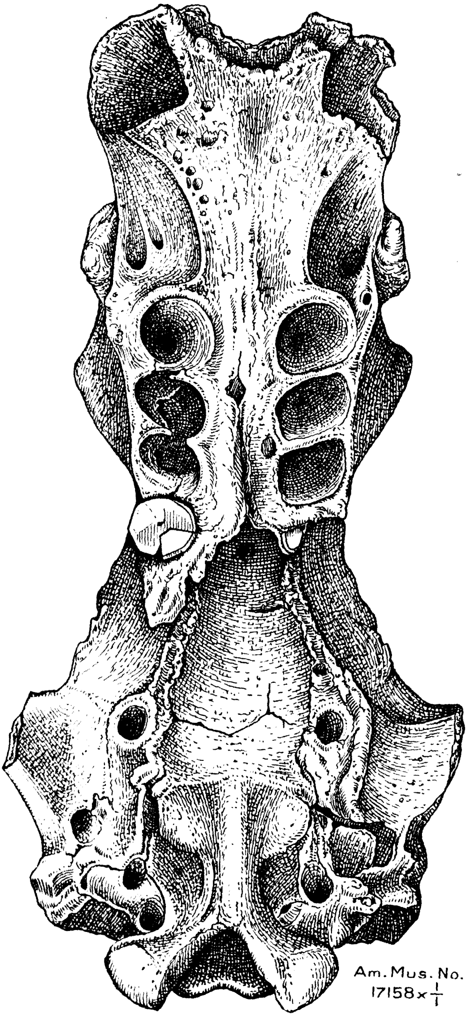

FIG. 60. *Acratocnus odontrigonus.* Utuado, Porto Rico. × 1/1

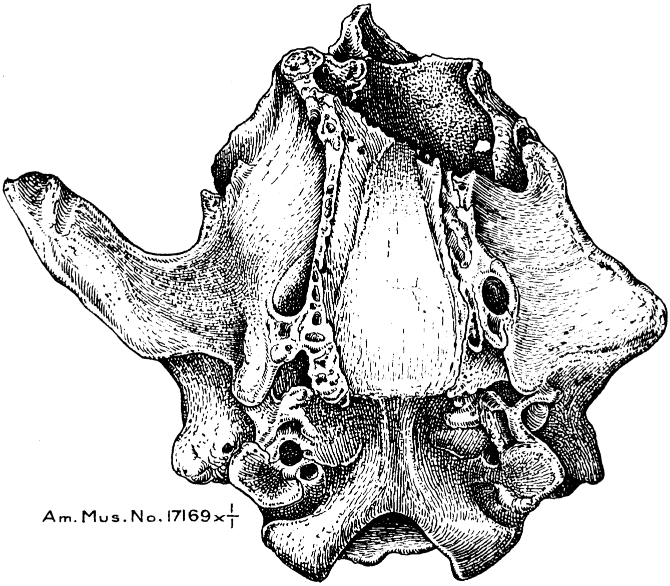

FIG. 61.—*Acratocnus major.* Utuado, Porto Rico. × 1/1

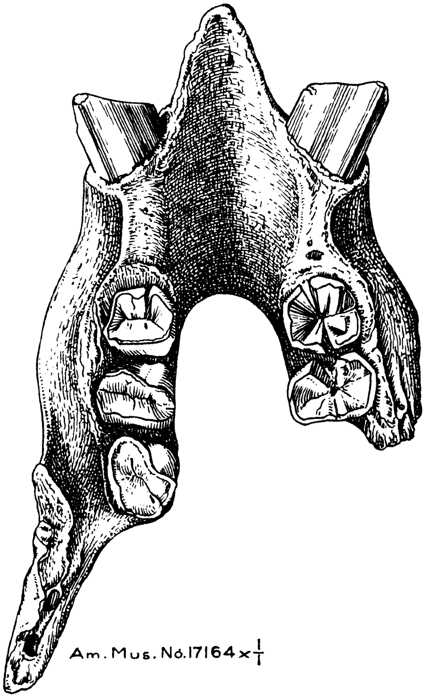

FIG. 62.—*Acratocnus odontrigonus.* Utuado, Porto Rico. × 1/1

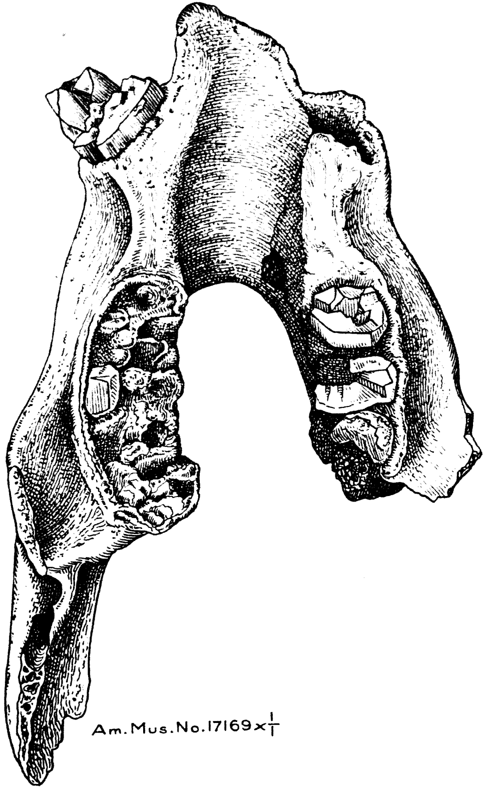

FIG. 63.—*Acratocnus major.* Utuado, Porto Rico. × 1/1

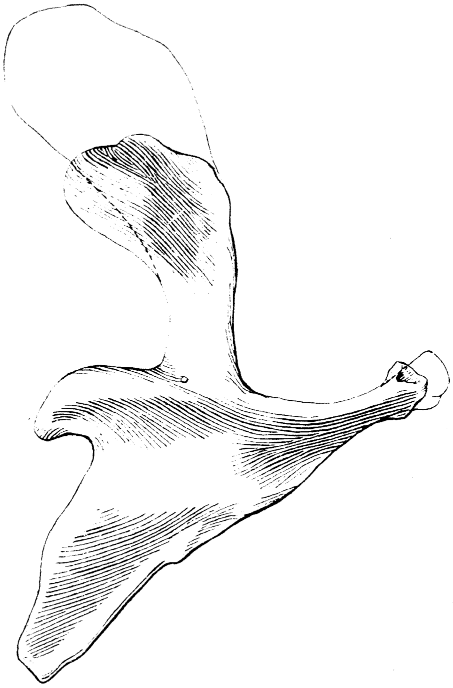

FIG. 64.—*Acratocnus odontrigonus.* Morovis, Porto Rico. Right malar. × 1/1

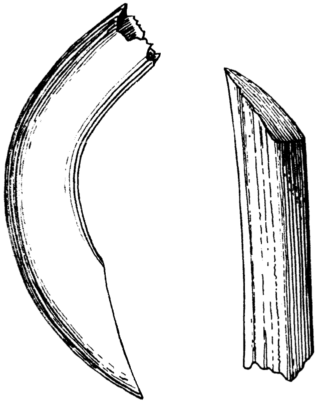

FIG. 65.—*Acratocnus odontrigonus.* Porto Rico. Upper and lower incisor. × 1/1.

Measurements of the Dentition of Acratocnus odontrigonus

Catalogue number of cranium	Dimensions of canine in cross-section*	Dimensions of first molar tooth	Dimensions of second molar tooth	Dimensions of third molar tooth	Dimensions of fourth molar tooth	Catalogue number of mandible	Dimensions of canine in cross-section	Dimensions of first molar tooth	Dimensions of second molar tooth	Dimensions of third molar tooth
17715.........	10.0 x 11.5	7.0 x 10.0	7.3 x 11.5	6.5 x 10.6	5.7 x 9.2	17712	10.6 x 7.3	....	7.4 x 12.0	....
17720.........	8.0 x 10.3	6.3 x 9.3	6.4 x 11.3	6.5 x 10.0	5.0 x 8.7	17713	9.0 x 6.3	8.0 x 9.7	7.7 x 11.0	8.0 x 10.6
17721.........	8.3 x 9.9	7.0 x 9.7	....	6.7 x 9.7	5.6 x 9.3	17714	10.3 x 6.0	....	....	8.3 x 9.9
17722.........	....	6.7 x 9.4	6.0 x 12.0	6.8 x 11.0	....	17717	9.6 x 6.2	7.0 x 8.6	6.5 x 10.3	7.8 x 10.0
						17718	9.3 x 8.0	8.0 x 10.3	7.7 x 11.8	9.0 x 11.3
						17719	9.0 x 6.6	....	....	....

* In each case the first measurement is taken in an antero-posterior plane, and the second measurement at right angles to the first.

Skeleton of *Acratocnus*

Both species, *odontrigonus* and *major*, are treated in the following description.

The scapula (text Fig. 66, Plate XLI) is large and strong, the blade divided into two nearly equal parts by the well-developed spine. The prescapular fossa is about equal in extent to the postscapular fossa. A large coraco-scapular foramen is present. The coracoid is strong and heavy. The glenoid cavity is spacious and well cupped; the articulating surface for the clavicle is extensive. The large subscapular fossa, the well-developed ridges and muscle insertion areas, all indicate a very powerful fore limb. *Acratocnus odontrigonus* has the scapula considerably smaller than in *major*, but the structures appear to be identical.

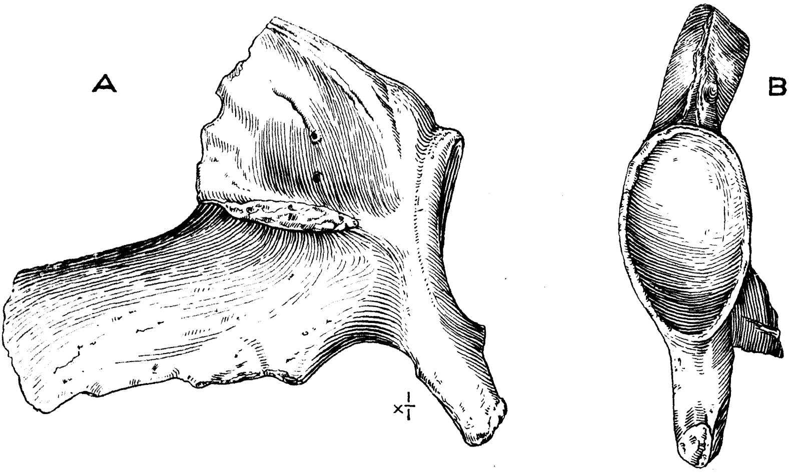

FIG. 66.—*Acratocnus odontrigonus.* Morovis, Porto Rico. Left scapula. A, external aspect; B, glenoid surface. × 1/1

Scapulæ collected.—*A. odontrigonus*, 15, of which one is perfect; *A. major*, the proximal ends of both scapulæ.

Measurements of Scapula of Acratocnus

	Dimensions of glenoid	Breadth of neck from coraco-scapular foramen	Greatest breadth of coracoid process	Greatest length, coracoid to edge of blade	Greatest breadth of blade at right angles to spine
A. odontrigonus					
17360 a...	15 x 23.0	28.0	....	....	....
17360 b...	14 x 21.6	23.7	....	....	....
17360 c...	13 x	25.0	....	....	....
17716 a...	16 x 24.0	30.0	20.0	125	69
17716 b...	16.8 x 24.0	29.6	16.5	....	73
A. major					
17169....	16 x 25.5	31.0	....	....	....

The humerus (text Figs. 67, 68, Plates XLIX, L) is a strong, heavy bone, very highly developed throughout. The head is moderately full and spherical, the tuberosities are strong and the position of the bicipital groove is occupied by twin grooves. The deltoid ridge is greatly developed and is expanded to form conspicuous internal and external crests, the former ending distally in a strong tubercle. The distal termination of the bone is broadly expanded and a wide flange for the supinator extends proximally almost half way up the shaft. The entepicondylar foramen is large and there is a small supratrochlear fossa. The internal condyle is very large and prominent. The entire bone is deeply marked by attachment areas.

The humerus of *major* is much the larger of the two species, but preserves practically the same details of structure.

Humeri collected.—*A. odontrigonus,* 25, of which several are perfect and others nearly so; *A. major,* the proximal end of one, the distal end of another.

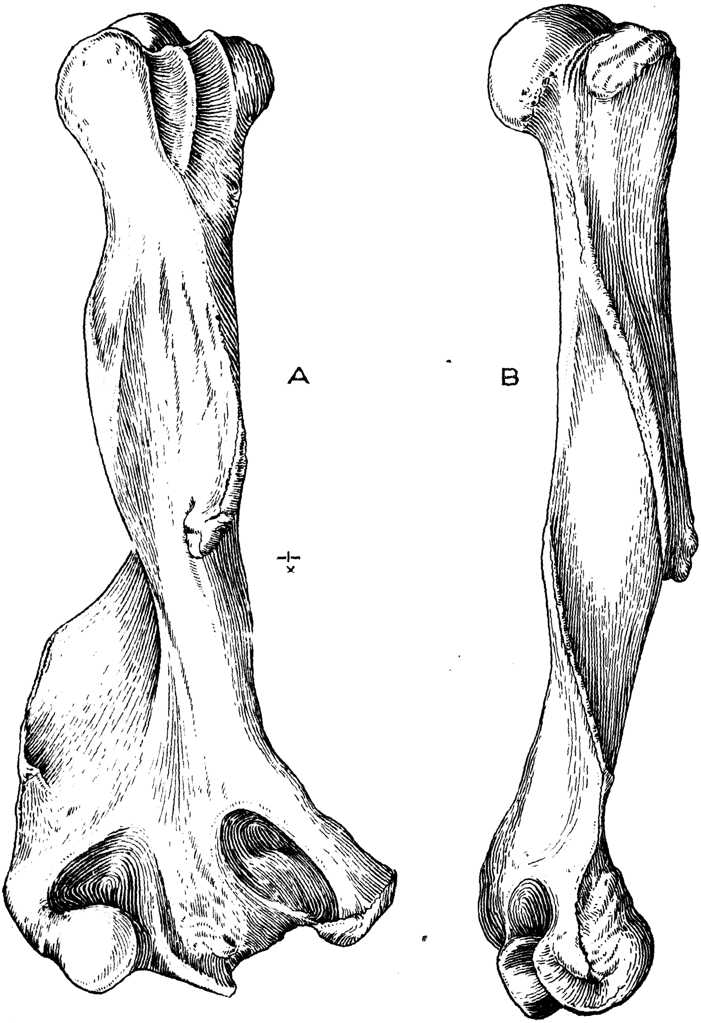

Fig. 67.—*Acratocnus odontrigonus.* Utuado, Porto Rico. A, anterior aspect of humerus; B, external aspect. × 1/1

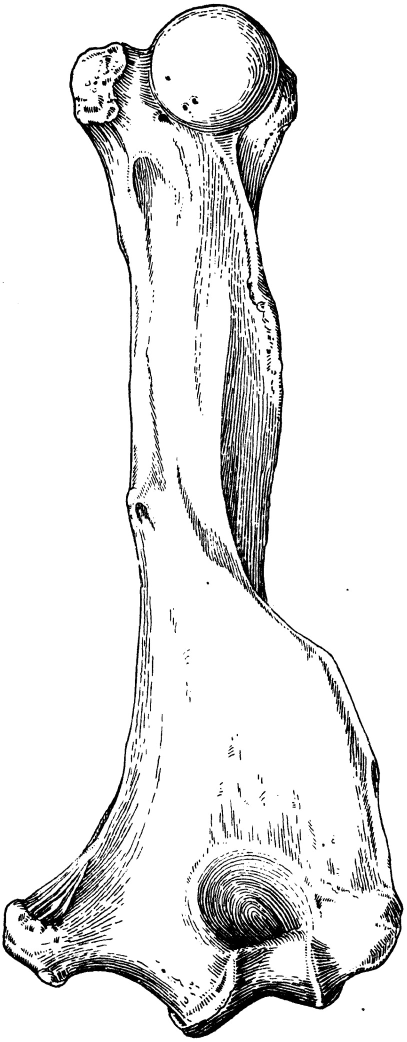

FIG. 68.—*Acratocnus odontrigonus*. Utuado, Porto Rico. Posterior aspect of right humerus. × 1/1

Measurements of Humerus of Acratocnus

	Greatest length	Diameter of head through bicipital groove	Breadth across tuberosities	Greatest breadth of deltoid ridge	Greatest breadth of expanded distal extremity	Least breadth of shaft, taken posteriorly
A. odontrigonus						
17361 a	134.3	24.0	30.5	20.4	52.0	13.0
17361 b	140.0	24.8	33.0	18.7	56.0	13.3
17361 c	145.0	24.7	33.8	19.0	55.0	14.3
17361 d	121.0	20.8	27.0	14.6	47.0	11.9
17361 e	...	24.0	35.0	22.0	...	13.5
17361 f	...	22.0	32.0	19.2	...	13.0
17361 g	...	...	32.5	18.3	54.0	12.7
17361 h	...	22.0	...	21.5	...	13.5
17361 i	...	23.8	30.3	21.5	...	13.0
17716 c	122.7	20.5	31.8	18.7	50.8	13.7
17716 d	132.7	25.0	35.0	20.0	56.0	14.0
17716 e	143.6	26.5	37.6	18.3	62.7	15.4
A. major						
17169	...	25.5	37.5	24.6	62.6	15.0

The clavicle (text Fig. 69) is short and thick, with a curved, twisted shaft and large sternal articulation.

Clavicles collected.—2, one of them perfect.

Measurements.—Greatest length, 56 mm.; dimensions of shaft midway, 4 x 7.7.

The ulna (text Figs. 70, 71, Plate L) is a strong, heavy bone, regularly curved from tip to tip, with the convexity directed posteriorly. The olecranon is short and thick, the sigmoid cavity large but shallow, and the distal articulation nearly flat, with scarcely any concavity. The posterior border is broad throughout its extreme length and slightly convex from side to side. There is a deep, longitudinal fossa along the proximal three-quarters of the internal aspect, and, in some individuals, a strong longitudinal ridge along the middle portion of the external aspect. The ulna of *major* is much more massive than that of *odontrigonus* and is more rugose throughout the attachment areas. The shaft is decidedly concave along both the external and internal faces.

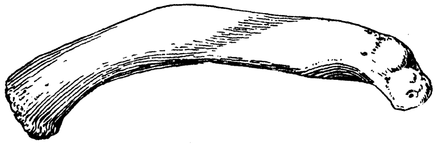

FIG. 69.—*Acratocnus odontrigonus.* Utuado, Porto Rico. Anterior aspect of clavicle. × 1/1

Ulnæ collected.—*A. odontrigonus,* 23 and a number of smaller fragments; seven ulnæ are perfect and others are nearly so; *A. major,* two ulnæ in a perfect state of preservation.

Measurements of Ulna of Acratocnus

	Greatest length	Length of olecranon from sigmoid cavity	Dimensions of shaft at a mid point	Diameter of sigmoid cavity
A. odontrigonus				
17362 a	160.0	20.0	10.0 x 17.0	21.0
17362 b	138.0*	24.0	7.3 x 17.6	20.5
17362 c	....	25.5	8.6 x 19.0	21.0
17362 d	....	25.5	7.3 x 16.2	19.0
17362 e	....	....	8.5 x 18.0	....
17711 a	150.5	18.0	7.0 x 19.4	23.0
17716 f	139.0	18.0	7.0 x 13.7	18.8
17716 g	156.6	22.0	7.0 x 18.0	20.0
A. major				
17169	171.0	26.0	13.4 x 21.6	25.0

* Lacking distal epiphysis.

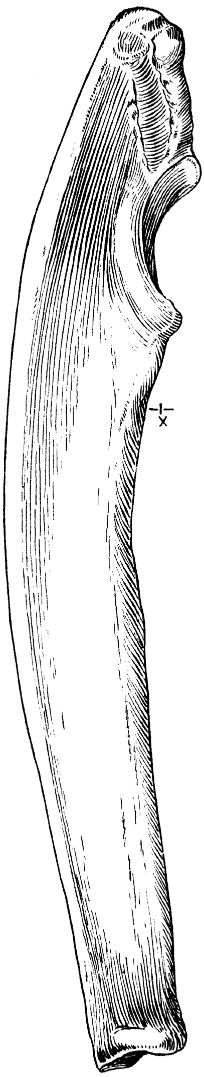

FIG. 70.—*Acratocnus odontrigonus.* Utuado, Porto Rico. Internal aspect of right ulna. × 1/1

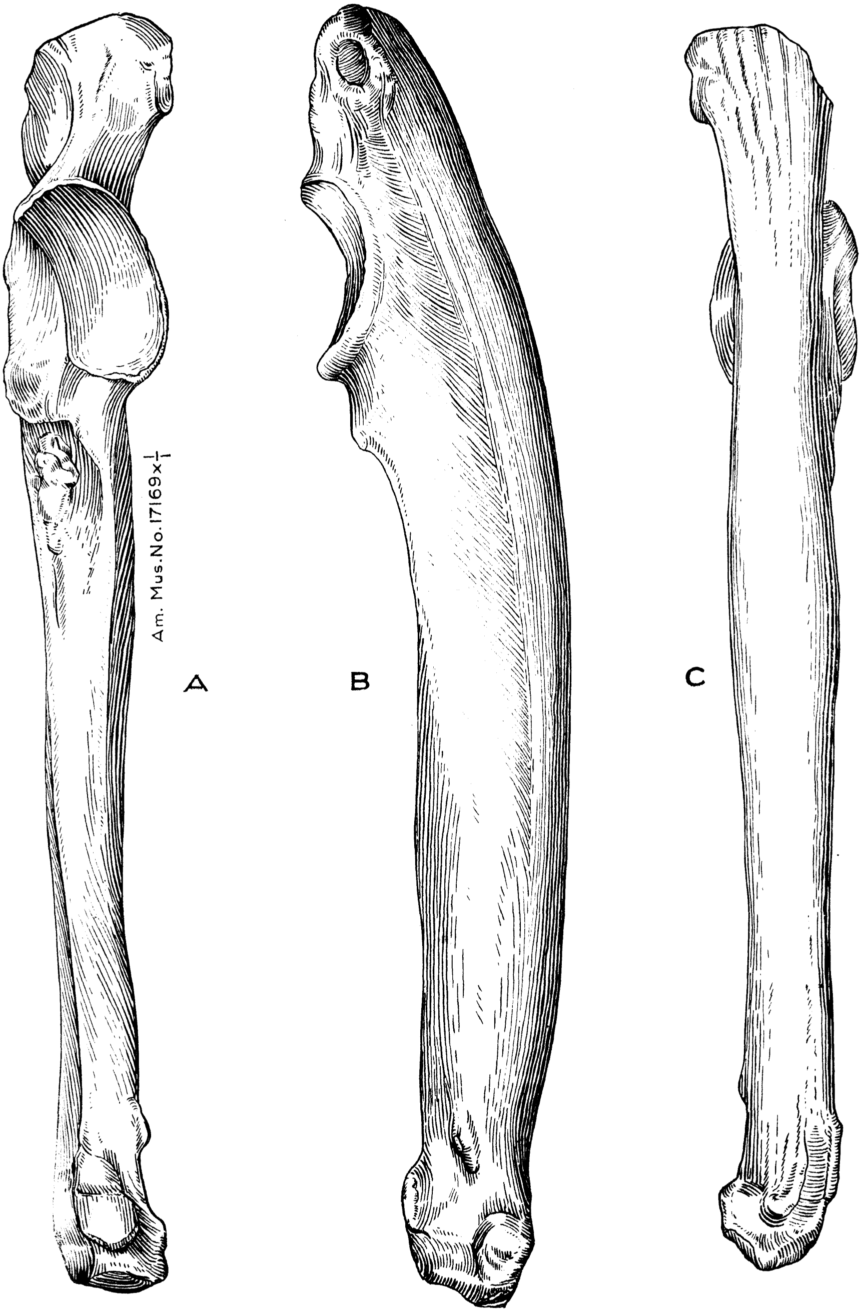

Fig. 71.—*Acratocnus major.* Utuado, Porto Rico. A, anterior aspect of right ulna; B, internal aspect; C, posterior aspect. × 1/1

The radius (text Fig. 72, Plate XLVIII) is a broad, flat bone with a strongly bowed shaft. The proximal termination is nearly circular and evenly concave, the tubercle is large and the distal extremity ends in a long, suboval concavity. The shaft is broader than deep throughout the proximal third; at this point it expands rather abruptly to a considerable breadth and this breadth is maintained to the distal extremity; posteriorly this expanded portion is concave. This bone is well marked by muscle areas and tendon grooves.

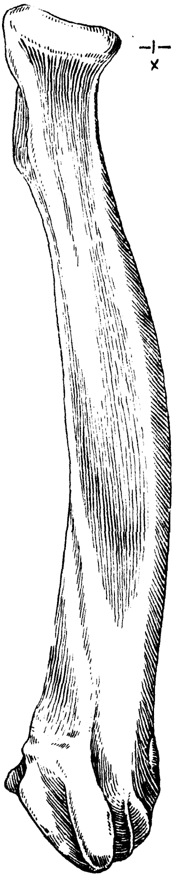

Fig. 72.—*Acratocnus odontrigonus.* Morovis, Porto Rico. Anterior aspect of right radius. × 1/1

The radius of *A. major* differs only in its much greater strength.

Radii collected.—*A. odontrigonus,* 37, of which 12 are practically perfect; *A. major,* a proximal and a distal portion.

Measurements of Radius of Acratocnus

	Greatest length	Dimensions of proximal termination	Dimensions of distal termination	Least transverse breadth of shaft	Greatest transverse breadth of shaft
A. odontrigonus					
17364 a...	128.8	15.0 x 18.0	....	11.6	23.5
17364 b...	112.0	13.0 x 16.0	13.0 x 19.0	10.0	14.0
17364 c...	113.0	13.0 x 14.4	14.0 x 21.0	9.6	19.0
17716 h...	119.0	13.6 x 14.5	15.7 x 23.0	10.7	18.0
17716 j...	120.8	12.0 x 14.2	15.0 x 19.6	10.7	16.0
17716 k...	131.0	16.0 x 17.5	18.4 x 26.3	12.0	21.8
A. major					
17169 ..	....	16.5 x 20.0	....	13.7	....

The ribs (text Fig. 73) are very strong and heavy, with broadly expanded shaft. The shaft curves evenly throughout most of its length and there is no apparent angle. The head and tubercle are both well developed.

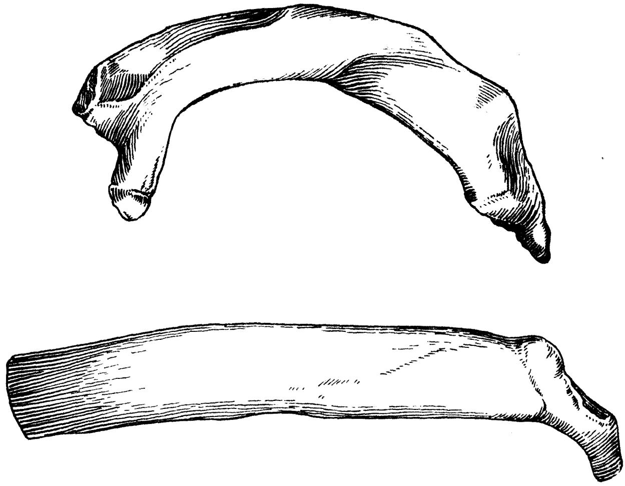

FIG. 73.—*Acratocnus.* Porto Rico. Ribs. × 1/1

Ribs collected.—392, many of them badly broken.

Measurements.—1st rib: length, 65 mm.; dimensions of shaft midway, x 11.

A portion of the sternum (text Fig. 74), with parts of 4 sternebræ nd costal attachments, shows that this part of the skeleton was heavy nd well proportioned.

A presternum, fused with one of the first ribs, is large and heavy, with a broad anterior lip, prolonged beyond the attachment of the first rib, and with a strong tubercle on the ventral surface posteriorly.

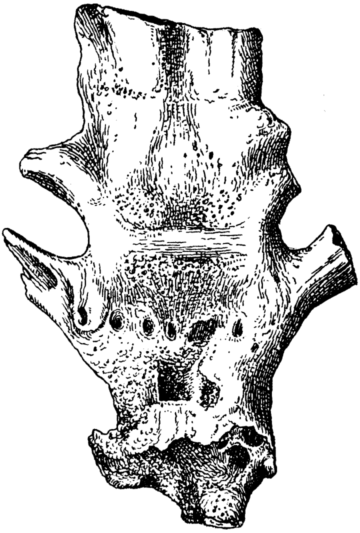

Fig. 74.—*Acratocnus odontrigonus.* Morovis, Porto Rico. External aspect of sternebræ. × 1/1

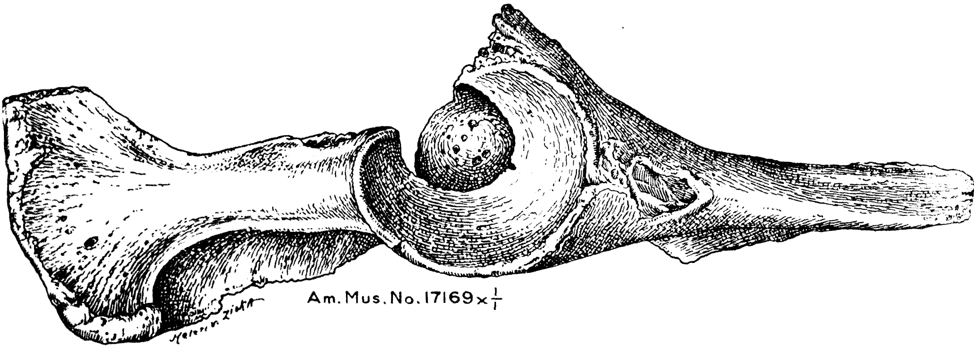

Fig. 75.—*Acratocnus major.* Utuado, Porto Rico. Lateral aspect of left innominate. × 1/1

Several fragments of the sacrum show that it is very thick and heavy, with a low dorsal ridge and not very widely expanded alæ.

Sacra collected.—7 fragments.

Measurements.—Length of two centra, 36 mm.; breadth across alæ, 74; depth through dorsal ridge, 34.5.

The innominate bone (text Figs. 75, 76) is large and massive. Only broken fragments of this element were collected, but they are sufficient to show that *Acratocnus* has a heavy, widely expanded ilium, a short, massive ischium with expanded posterior border and long pubes which fuse firmly at the symphysis. The acetabulum is deep and the cotyloid notch well developed.

Innominate bones collected.—47 pieces, representing probably 4 individuals at least, one of which is *A. major.*

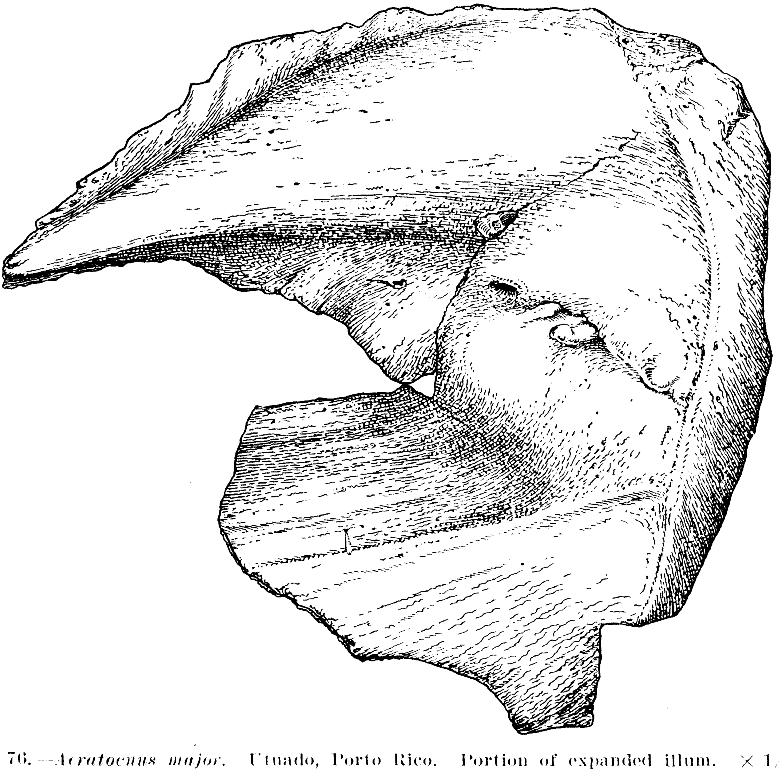

FIG. 76.—*Acratocnus major.* Utuado, Porto Rico. Portion of expanded illum. × 1/1

Measurements.—All of *A. major.* Least breadth of ilium near acetabulum, 35.7 mm.; approximate breadth of expanded portion of ilium, 110; length of ischium from acetabulum, 51; greatest diameter of acetabulum, 31; length of pubic symphysis, 17.4.

The femur (text Figs. 77–78, Plates LI, LII), although very strong and robust, has not acquired the extremely expanded shaft characteristic of most of the members of this family. The head is very well rounded, symmetrical, and represents a hemisphere; the constriction at the neck

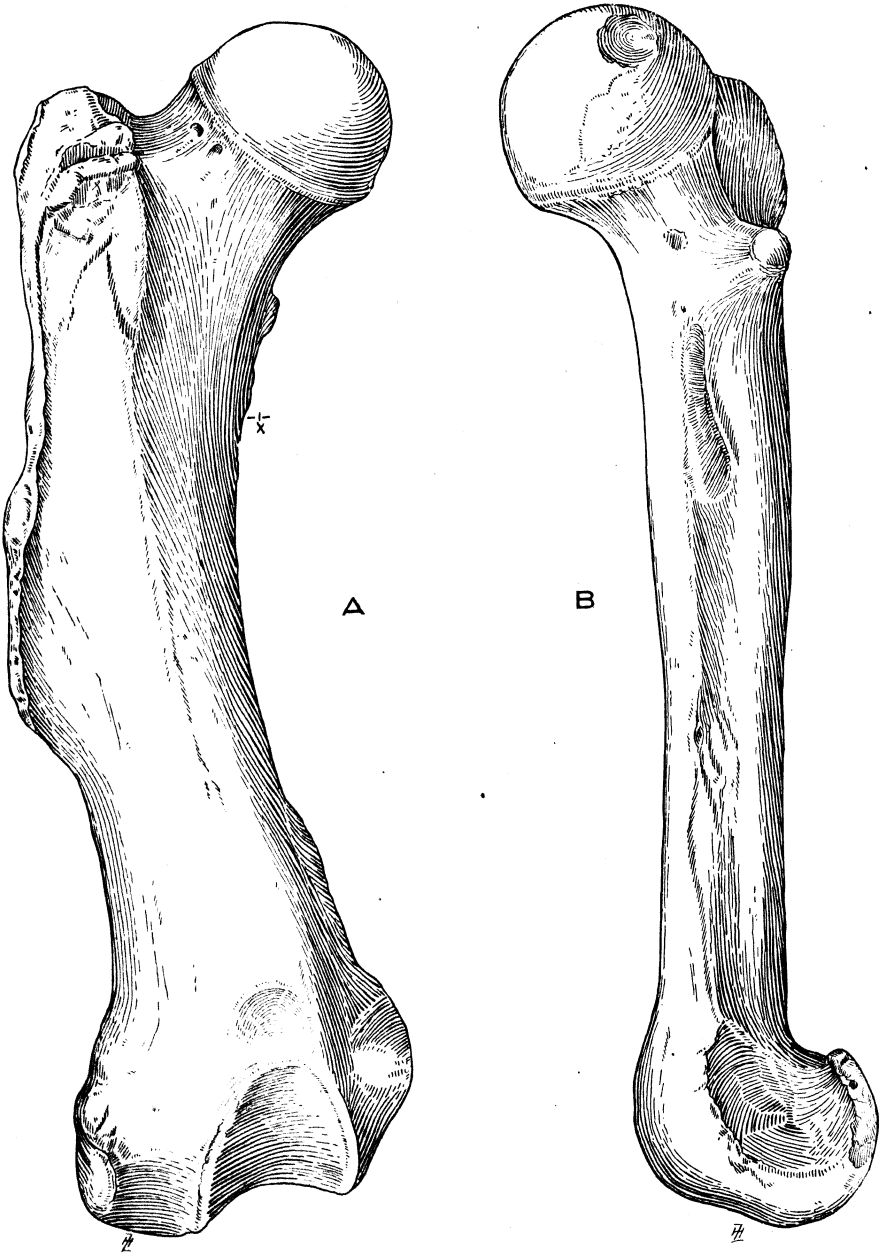

FIG 77.—*Acratocnus odontrigonus.* Morovis, Porto Rico. A, anterior aspect of right femur; B, internal aspect. × 1/1

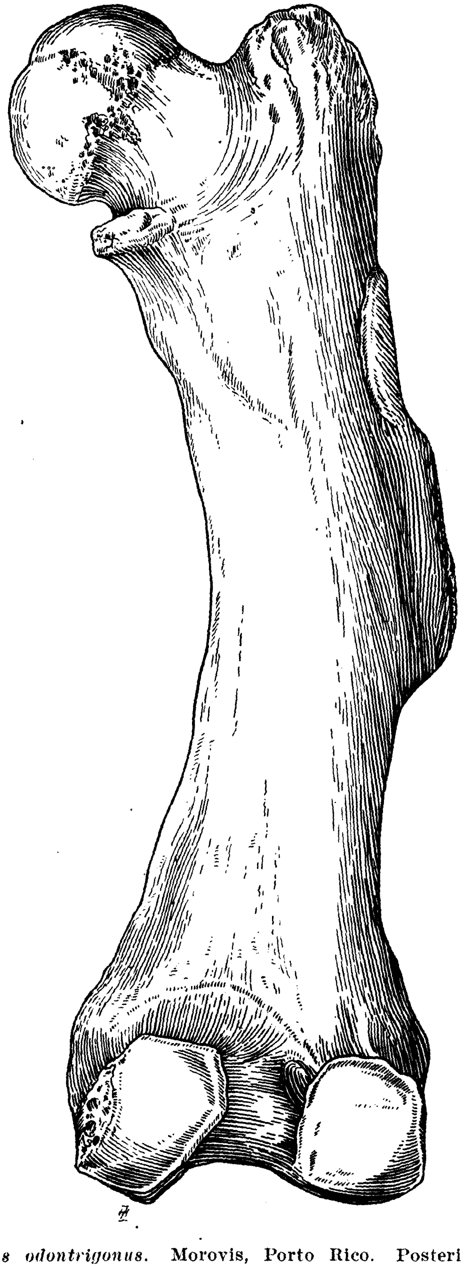

FIG. 78.—*Acratocnus odontrigonus.* Morovis, Porto Rico. Posterior aspect of right femur. × 1/1

is slight and the fossa for the ligamentum teres is large and well defined. The greater trochanter is thick, rugose and rather low, not reaching to the top of the head; and the lesser trochanter is a well-developed tubercle. There is no digital fossa, but a well-marked intertrochanteric ridge is present. The third trochanter is a long, low, thickened ridge on the external border of the shaft. The condyles are large and heavy and the trochlea is broad. The shaft narrows from either extremity toward the middle and nowhere throughout the mid-portion is nearly as wide as at either extremity. Attachment areas are very well indicated.

The variation in size shown by the series of femora is considerable. The femur of the type, as chance had it, is one of the smallest and consequently gave the early impression that the Porto Rican sloth was a much lighter-limbed animal than it now appears to be. Several of the series of femora are smaller and slender, like the type femur, but most of them are noticeably more robust. None of them approach in this respect the femur of *Megalocnus*. The femur of *A. major* is decidedly heavier than that of *odontrigonus*, as will be seen by the table of measurements, but in the few characters to be obtained from the broken specimens does not appear to differ otherwise.

Femora collected.—*A. odontrigonus*, 37, of which 20 are perfect or nearly so; *A. major*, a head and distal extremity.

Measurements of Femur of Acratocnus

	Greatest length	Diameter of head	Distance from greater to lesser trochanter	Breadth of shaft through third trochanter	Least breadth of shaft distal to third trochanter	Depth of shaft, antero-posteriorly, at same point	Breadth across condyles	Depth through condyles
A. odontrigonus								
17363 a	157.0	27.0	44.0	32.5	26.3	14.6	48.0	33.0
17363 b	163.3	25.6	48.0	29.0	26.3	16.4	44.3	30.8
17363 c	148.0	23.3	44.0	26.0	25.0	15.6	43.4	30.0
17363 d	144.4	25.0	....	27.4	24.0	15.0	43.0	30.0
17363 e	135.5	22.5	40.0	22.0	19.0	14.0	41.7	29.0
17363 f	....	26.9	45.0	32.0	26.5	16.4	....	....
14172	138.3	22.3	39.4	21.5	18.0	12.8	38.0	26.8
17711 b	137.0	22.2	43.0	25.0	18.7	12.5	37.7	25.5
17711 c	157.0	27.5	47.5	26.8	24.5	16.3	50.0	30.0
17716 l	145.5	23.8	44.0	28.4	22.4	14.0	41.0	29.3
A. major								
17169	....	32.3	....	....	....	19.8	50.5	35.5

The tibia (text Figs. 79, 80, Plate XLVII) has an expanded, knob-like proximal termination and a broad, flattened distal end. The shaft, viewed from in front, is nearly straight, with a gentle concavity externally; from the rear this concavity is much more pronounced. The articulating surfaces at each extremity are large and nearly flat. The articulation for the fibula faces obliquely downward and slightly forward. The shaft is rather smooth and not roughened by muscle attachments, but the tendon grooves on the distal extremity are deep and well defined.

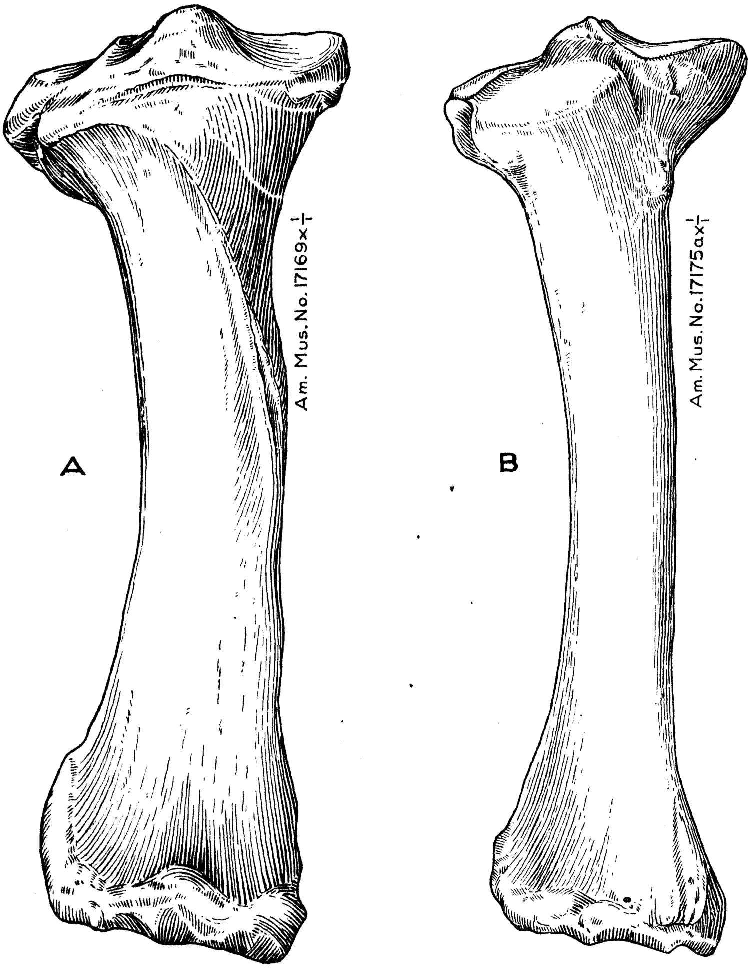

FIG. 79.—*Acratocnus major.* Utuado, Porto Rico. A, anterior aspect of right tibia. × 1/1. *Acratocnus odontrigonus.* Morovis, Porto Rico. B, anterior aspect of right **tibia.** × 1/1

The tibia of *A. major* is much the heavier and more rugose of the two species.

Tibiæ collected.—*A. odontrigonus,* 36, a number of which are perfect; *A. major,* 1 complete and the proximal extremity of the other.

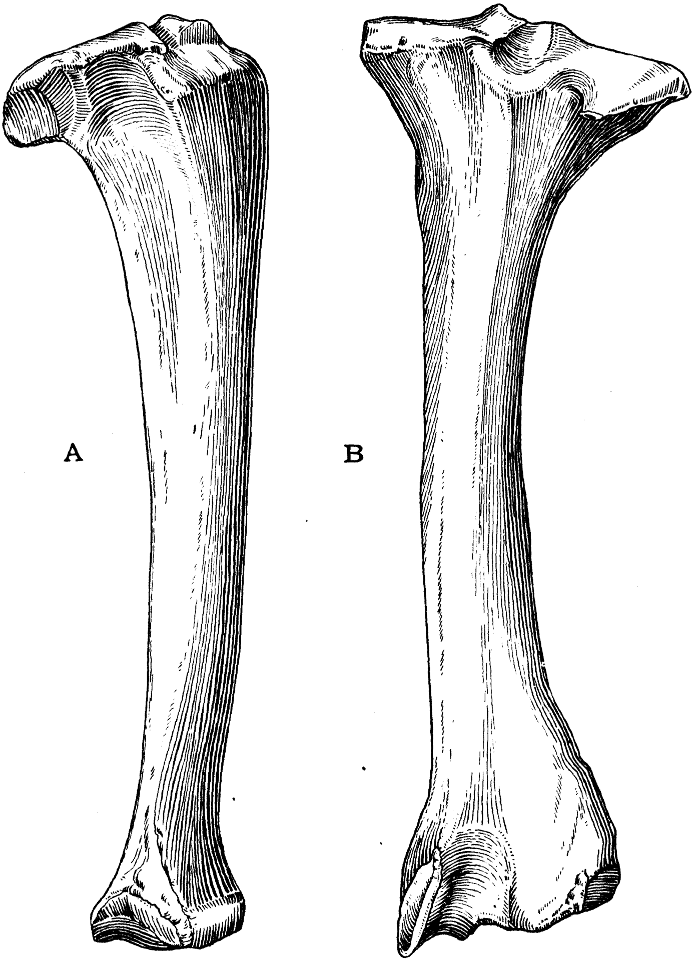

FIG. 80.—*Acratocnus odontrigonus.* Morovis, Porto Rico. A, external aspect of right tibia; B, posterior aspect. × 1/1

Measurements of Tibia of Acratocnus

	Greatest length	Breadth across proximal extremity	Breadth across distal extremity	Breadth of shaft at mid-point	Depth of shaft at same point	Depth across proximal extremity	Depth across distal extremity
A. odontrigonus							
14172........	113.5	33.0	27.0	13.4	8.7	31.0	17.5
17175 a.......	128.0	44.4	32.2	13.3	13.2	31.5	20.0
17175 b.......	111.0	39.0	29.0	12.0	13.0	34.0	19.0
17175 c.......	120.0	40.0	32.0	17.0	14.0	34.0	20.0
17175 d.......	116.0	37.5	....	13.0	14.6	32.0	17.5
17175 e.......	....	41.4	....	14.0	14.5	32.0	....
17711 d.......	127.6	44.0	31.6	17.7	15.5	35.3	22.3
17716 m......	119.0	41.0	31.0	14.4	13.6	31.8	18.6
17716 n.......	139.0	40.0	34.7	18.0	13.0	34.0	21.0
A. major							
17169........	133.0	51.0	39.0	20.0	18.0	38.6	25.0

The fibula (text Fig. 81, Plate XLVIII) is not fused to the tibia at either extremity and is a strong, well-developed bone. Proximally it terminates in a flat, expanded sheet and distally in a thickened club-like knob. The shaft is slightly curved, with the convexity directed outward.

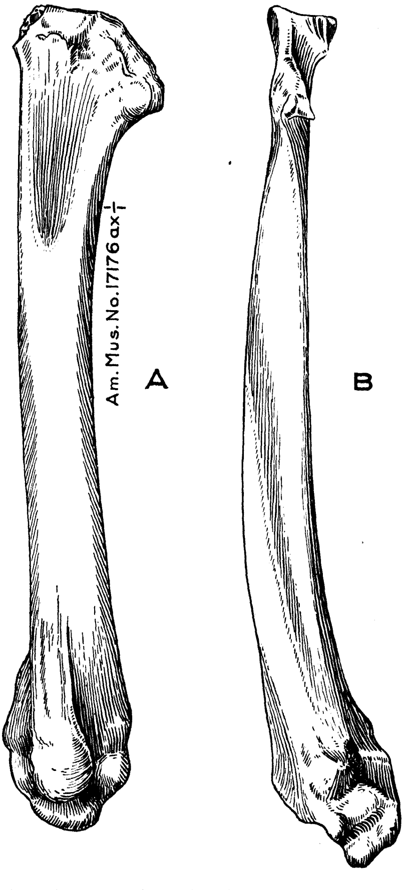

Fig. 81.—*Acratocnus odontrigonus.* Utuado, Porto Rico. A, external aspect of left fibula; B, posterior aspect. × 1/1

The fibula of *A. major* differs, as far as may be determined from the available material, only in its much greater size and massiveness.

Fibulæ collected.—A. odontrigonus, 27, of which 11 are complete; *A. major,* 2 proximal and 1 distal termination.

Measurements of Fibula of Acratocnus

	Greatest length	Breadth across proximal termination	Breadth across distal termination	Dimensions of shaft at a mid-point
A. odontrigonus				
17176 a	109.0	21.0	17.0	8.0 x 8.0
17176 b	111.0	21.0	16.0	9.4 x 7.0
17176 c	....	....	17.0	7.4 x 7.4
17176 d	....	....	17.2	9.0 x 8.0
17176 e	....	20.6	....	10.0 x 8.0
17716 p	115.8	19.0	15.0	7.3 x 8.0
17716 q	115.0	24.3	18.6	9.0 x 10.0
17716 r	130.4	21.0	18.7	12.7 x 7.8
A. major				
17169	....	....	22.0	....

The calcaneum (text Fig. 82, Plate LII) is very well developed. Distally it extends as a broad, expanded body, reaching its greatest breadth near the extremity. Rotation inward of the lower border of the distal portion produces a shallow concavity on the internal face. The extreme border of this extremity is thickened and roughened for tendon attachment. The articulating facets are all well developed and large, the posterior astragular facet facing obliquely upward and forward, the anterior facets for the astragulus and cuboid facing respectively obliquely upward

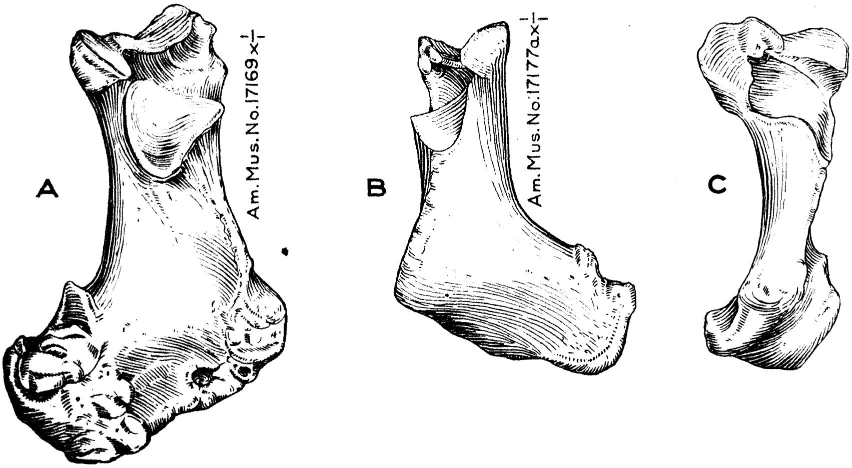

FIG. 82.—*Acratocnus major.* Utuado, Porto Rico. A, right calcaneum. *Acratocnus odontrigonus.* Utuado, Porto Rico. B, C, left calcaneum. × 1/1

and forward. There is a slight expansion of the calcaneum proximally.

The calcaneum of *A. major* is very much more massive than that of *odontrigonus*, but has retained the same disposition and proportion of the facets.

Calcanea collected.—A. odontrigonus, 23, most of them complete; *A. major*, 2.

Measurements of Calcaneum of Acratocnus

	Greatest length	Greatest transverse breadth of proximal extremity	Greatest transverse breadth of distal extremity	Least breadth between posterior astragular facet and tip of distal superior border
A. odontrigonus				
14170	43.0	20.0	30.0	11.0
17177 a	49.0	21.6	33.0	12.0
17177 b	46.8	17.0	29.4	11.0
17177 c	31.0	20.5	34.0	11.6
17177 d	49.0	....	31.0	13.0
17711 e	47.7	20.7	30.5	10.5
17716 s	56.5	22.8	38.0	13.5
17716 t	56.7	22.2	35.0	14.0
A. major				
17169	58.0	27.5	39.5	15.0

The astragulus (text Fig. 83, Plate LII) is of the long-necked type. Anteriorly it terminates in a well-cupped facet for the scaphoid, and continues posteriorly with but very little constriction at the neck. Posteriorly it rises in a well-developed but somewhat low, convex articulation for the tibia. The facets for the calcaneum and fibula are very large and well developed.

The astragulus of *A. major* is much wider and heavier than that of *odontrigonus*, but it is only slightly longer, resulting in a slight change of proportions, the most noticeable being the shorter neck of *major*.

Astraguli collected.—A. odontrigonus, 9, in perfect condition; *A. major*, 1, perfect.

Measurements of Astragulus of Acratocnus

	Greatest length	Breadth across anterior extremity	Greatest breadth across tibial articulation	Greatest depth through tibial articulation
A. odontrigonus				
17178 a	31.0	15.5	14.4	17.0
17178 b	31.6	17.0	13.4	16.7
17716 u	30.5	15.7	12.8	17.0
17716 v	34.3	16.7	15.7	18.0
17716 w	35.4	20.5	16.0	19.0
A. major				
17169	35.0	21.0	20.0	20.0

The carpus and tarsus are only poorly represented and no attempt has been made to fit the scattered elements together since so many are lacking that the determination is difficult.

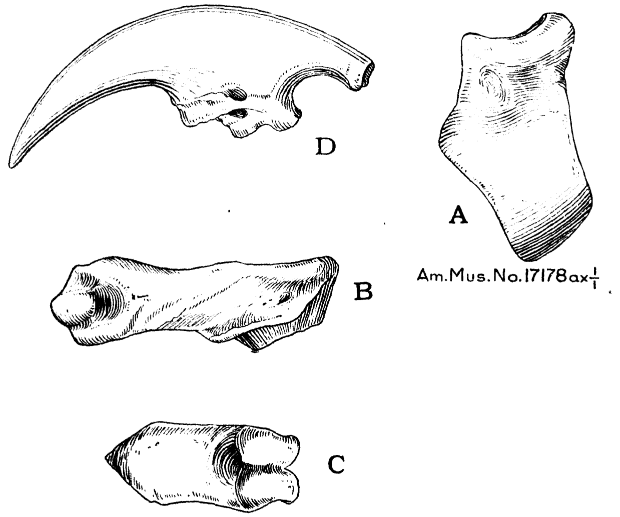

FIG. 83.—*Acratocnus odontrigonus.* Porto Rico. A, dorsal aspect of left astragulus; B, metatarsal; C, phalanx; D, ungual phalanx. × 1/1

The scaphoid is rather thin in the antero-posterior plane and has a large, full articulation with the astragulus.

Measurements.—Greatest thickness in antero-posterior plane, 4.4 mm.; greatest depth dorso-ventrally, 6.2.

The metacarpals and metatarsals (text Fig. 83) are short and thick, with angular articulating surfaces proximally and strongly keeled term nations distally. The phalanges have very well-developed articulations, with sharp, median keels and deep, pulley-like surfaces. The terminal or ungual phalanges are strong, heavy claws and well bent.

Metacarpals and metatarsals collected.—65.

Phalanges collected.—31.

Terminal phalanges collected.—124. (See Plate LIV.)

Vertebræ.—(Text Fig. 84, Plate LIII.) The atlas is large and strong, with rather short transverse processes and a very low tubercle. This element appears to be exceedingly variable. One specimen has a well-developed tubercle and narrow transverse processes, and differs so in appearance from the other atlases that it requires an elastic conception of the species to reconcile the two types. However, the circumstances preclude the possibility of this particular atlas belonging to anything other than *Acratocnus,* and I am unable to correlate the difference in the atlas with specific differences in the other material from the same cave, so prefer to consider the difference as individual variation.

Atlases collected.—A. odontrigonus, 4; *A. major,* 1.

The axis is well developed, having a very stout odontoid, a deep, median ventral ridge, a strong dorsal spine and weak transverse processes.

Axes collected.—A. odontrigonus, 3; *A. major,* 1.

The cervicals (text Fig. 84) have short centra of ovate cross-section, low dorsal spines on the anterior vertebræ of the series, well-developed anterior and posterior zygopophyses, broad but short transverse processes and large vertebral canals.

Cervicals collected.—A. odontrigonus, 16; *A. major,* 1.

The thoracic vertebræ (text Fig. 84) have centra with cross-section varying from ovate cephalad to round or subtriangular caudad; the dorsal spines are strong and of normal height, the transverse processes are well developed cephalad in the series, shorter and higher up on the pedicle caudad. Anteriorly in the series, the head of the rib articulates with two centra, but posteriorly the articulation is entirely on the same vertebra that receives the rib tubercle.

Thoracics collected.—A. odontrigonus, 143; *A. major,* 11.

The lumbars (text Fig. 84) are large, with deep centra, strong transverse processes, deeply interlocking articulations and very low dorsal spines.

Lumbars collected.—A. odontrigonus, 20; *A. major,* 4 of the type series and 1 of an odd individual.

The caudal vertebræ (text Fig. 84) are very characteristic and the common feature of the entire series is the widely expanded and flaring transverse process. The size of the vertebræ decreases rather abruptly

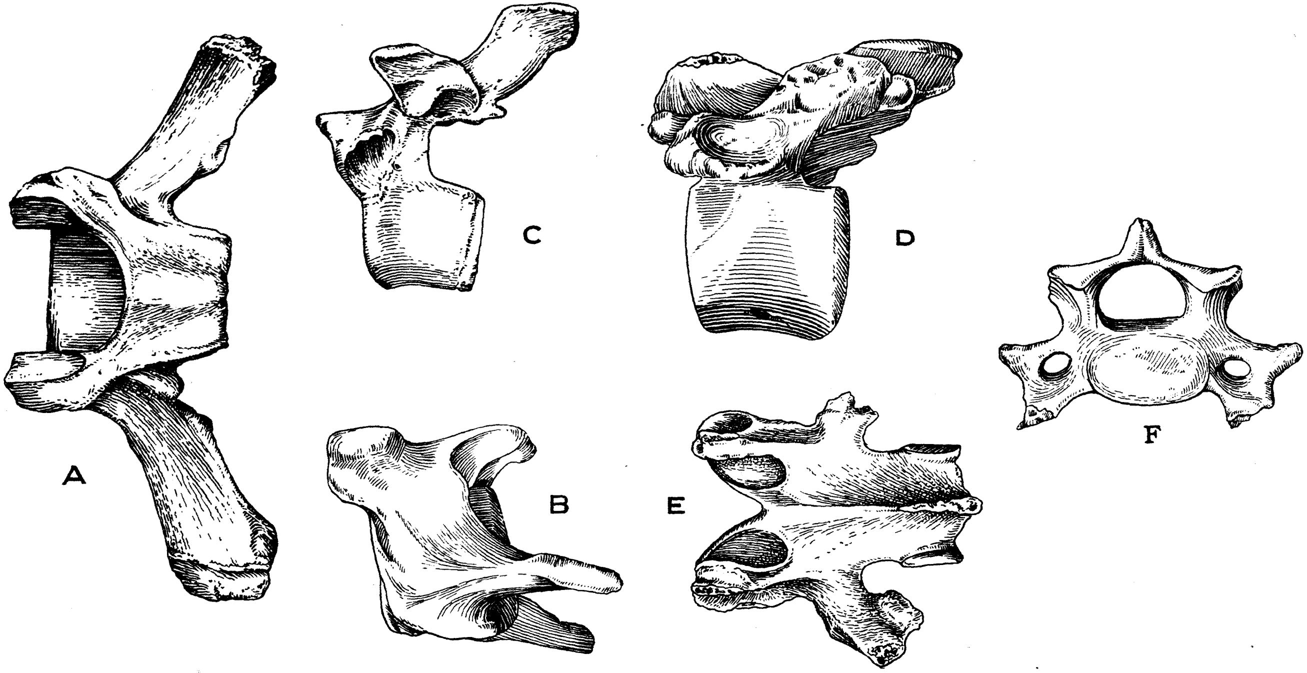

FIG. 84.—*Acratocnus.* Porto Rico. A, dorsal aspect of caudal vertebra; B, lateral aspect of same vertebra; C, lateral aspect of thoracic vertebra; D, lateral aspect of lumbar vertebra; E, dorsal aspect of same vertebra; F, cervical vertebra. × 1/1

from the very large members of the series, with subquadrate or subcircular centra, to the small ones, with flattened, depressed centra. The large ones have a low, flattened neural arch with well-developed zygopophyses, but toward the end of the series the neural arch is lost and the zygopophyses become vestigial and finally disappear completely. The tail of *Acratocnus* is indicated by the rather complete set of caudals as being quite short. Although in some instances the caudals of *odontrigonus* and *major* may be distinguished, it is very difficult to draw a dividing line, and the material is consequently listed in the aggregate.

Caudals collected.—100. (See Plate LIII.)

The vertebræ of *A. major* in most cases differ from those of *odontrigonus* only in point of size. The range of variation in the size of individuals of *odontrigonus* is large, but the largest of this species lacks considerable of attaining the size of *major*. The most noteworthy feature of the column in general is the lowness of the dorsal spines. Throughout most of the series the dorsal spines are very low, and even when they reach their greatest height in the thoracic series the spines are directed obliquely backward and the actual height above the pedicle is slight.

Measurements of Vertebræ of Acratocnus

	Vertical diameter of centrum	Length of ventral wall or length of centrum	Breadth across transverse processes	Greatest depth or depth through dorsal spine to ventral border of centrum
Atlas	....	9.7	52.8	24.7
Atlas*	....	12.5	....	28.0
Axis*	7.0	28.3	37.0	....
Cervical, 4th?	9.0	6.4	40.4	25.0
Cervical, 6th?	8.2	11.2	36.6	33.6
Thoracic, 2nd?	8.8	12.0	35.0	46.4
Thoracic, 10th?	13.2	15.5	31.8	40.0
Lumbar	14.0	17.5	35.8	44.0
Lumbar*	18.5	21.2	52.0	50.0?
Caudal*	18.0	17.0	71.0	27.0
Caudal*	9.6	10.0	35.0	....

* *A. major.*

Relationships of *Acratocnus*

The two species of *Acratocnus* appear to be very closely related. ratocnus major is merely a larger relative of *odontrigonus*, and the racter of size is the best one for determining the material. The larger sloth has proportionally a much broader muzzle and an elevated basioccipital region.

Apparently there is considerable individual variation within the species *odontrigonus.* The type is one of the smallest individuals of the series, and because of its small size the name *Acratocnus* was taken. Later material proves that the average size is well above that of the type, and the differences between the extremes suggest that there may be a sexual differentiation in size.

Acratocnus is well marked off as generically distinct from *Megalocnus* of Cuba. Aside from the great size difference, with its changes of proportion, there are numerous differences in the skull and dentition, the more important of which are the shape of the canines, trigonal in *Acratocnus,* subquadrate or roughly sublunar in *Megalocnus,* and in *Megalocnus* the lack of a sagittal crest, large preorbital fossæ and symphyseal tongue.

The relationship of *Acratocnus* with the more primitive of the Santa Cruz Megalonichidae is well shown by a comparison with *Eucholoeops* and *Hapalops.* *Eucholoeops* agrees with *Acratocnus* in the possession of a developed sagittal crest (not as well developed, however), large preorbital fossæ, subtrigonal and differentiated upper canines and well-developed symphyseal tongue. *Hapalops* resembles *Acratocnus* in its light-limbed skeleton and particularly in the structure of the pes.

Acratocnus in some characters shows a tendency toward semi-arborealism, such as the long-necked astragalus, and this genus and the modern tree-sloths have a number of characters in common.

THE ORIGIN OF THE MAMMALIA OF PORTO RICO

The problem of the origin of the mammalia of Porto Rico is but a part of a larger problem which concerns the origin of the mammalia of the Antilles as a whole. Most of the facts and arguments connected with the various attempts at solution of this problem are well enough known to students of the West Indian faunas, and it seems almost trite to repeat what has been said so often before; but, in order to make this report complete, it is necessary to go over the salient features of this question. In this discussion my use of the term fauna carries especial reference to the mammalian fauna.

It should occasion no surprise if we found the Antilles today without any mammals other than a few waifs from the continental mainland differing from mainland forms in varying degrees. Should this be the case, and disregarding for the moment all other evidence, we would be well justified in considering the islands to be of oceanic origin. If, on the other hand, we should find the Antilles with a large and varied fauna, comparable in most respects to that of either North, Central or South America, we would be equally well justified in assuming that the islands were of continental origin, and there would be scant ground for argument. However, the true condition of affairs lies between these two hypothetical conditions, and the problem is far from a simple one.

A great deal has been written upon the geological history of the West Indies.[14] While there is a division of opinion among the geologists as to the origin of the Antilles, I think it is safe to assert that today the majority are inclined to favor a continental connection during some part of the Tertiary. The major features of the Caribbean and North Atlantic submarine topography are sufficiently well known through the cruises of the *Blake,* the *Albatross* and other hydrographic researches to furnish the basis for a hypothetical restoration of Tertiary conditions (see map on page 240).

In general, it may be said that the Antilles are surrounded by great ocean depths, with numerous banks or submarine plateaus covered by much shallower waters. Here and there throughout the area occur deep canyons or chasms in the ocean bottom, which are considered by some writers to be lying along geologic fault-planes. The presence of active volcanoes in some of the Antilles today and the evidence of extensive volcanic activity in the past, together with the existence of these great rifts in the submarine topography, show that the Antillean area is one of seismic activity, with potentiality for major displacements of this part of the surface of the earth.

From inspection of the map on page 240, based on data from the U. S. Hydrographic Office, it will be readily noted that an elevation of the ocean floor of 600 feet would produce considerable change in the dry-land area of the Antilles. It will be observed that one of the most extensive of the shallow-water areas extends eastward and northeastward from Honduras, with a similar shallow bank from Yucatan northward and eastward toward Cuba. The presence of these two sections of elevated ocean floor bears a significant relationship to a hypothetical former mainland connection with the Greater Antilles. Two other areas of elevated ocean floor will be found on the map, one bearing southward from the Bahamas toward Cuba and Haiti, the other extending northward from Trinidad more or less the entire length of the Lesser Antilles. Whether or not these latter two areas point to a Tertiary fusion of the Greater Antilles with the continents of North or South America, which seems to me to be unlikely, has little or no bearing upon the origin of the mammalia of the Antilles, since it will be shown later that such mammals as are found in this region today can scarcely have migrated through these two assemblages of small islands. The two important potential points of contact with continental America are Honduras and Yucatan.

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[14] See bibliography for references on origin of West Indies.

The stratigraphy of the Greater Antilles shows that these islands have not maintained a consistent level above the seas. Marine limestones, in many places found today at an elevation of several thousand feet above sea-level, show us that there has been a considerable fluctuation in the area above water. Hill (1899, p. 165), writing on Jamaica, states:

> The first or great primary oscillation was that embraced in the cycle of the Cambridge-Montpelier descending, and the early Oligocene ascending movement. This subsidence was certainly 3,000 feet, as can still be measured by the height to which the bases of the old pre-existing mountain summits are plastered with its deposits. When we remember that the present land surface of Jamaica is only the crest of a larger Jamaica still submerged, it would be no stretch of the imagination to believe that the movement was from twice to thrice the amount given. In fact, there is very direct evidence which leads us to the latter conclusion.
>
> The purity of the Montpelier chalks and their dominant composition of Globigerinae would indicate that they were deposited like the deep sea oozes of to-day at depths of 1,200 and 2,300 fathoms. The fact that in the eastern end of the adjacent island of Cuba the stratigraphic and time position of these beds is occupied by Radiolarian earths which are now known to abound from 2,000 to 4,000 fathoms (12,000 to 24,000 feet) justifies us in premising that the Globigerina beds of Jamaica were laid down in very deep waters. It would not be at all unfair to assume the average between the minimum and maximum of the Globigerina and Radiolarian depths as 1,750 fathoms, or over 10,000 feet, as the mean of this subsidence at Jamaica. The assumption of a minimum depth has additional support in the fact that the Jamaican Globigerina deposits were close to the slope of the nucleal islands which persisted as tips of land during this epoch.
>
> The succeeding Post-Montpelier upward movement brought up the bottom not only to sea level (+ 10,000 feet), but raised it at least 3,000 feet above it, which would equal an elevation of 13,000 feet. As the highest mountain peaks of Jamaica now stand 4,325 feet above the material deposited in the Montpelier subsidence, they must have reached at the culmination of this elevation altitudes of over 17,000 feet above the sea. As great as these heights may seem, they do not greatly exceed that of the summit of the Sierra de Santa Marta, which now stands beside the Caribbean shore of Colombia, and of other known high peaks like Orizaba and St. Elias adjacent to the Pacific shore lines of our own continent.
>
> So grand a subsidence and elevation as this must surely have left some record in the present submarine topography of the whole region, and we cannot contemplate maps of such phenomena without coming to some very definite opinions which will be elucidated in Part V. Neither could the max-

mum of elevation have failed to expand the areas of the Antillean lands, and to unite many of the islands or even the mainland together, especially had their geographic areas been greater then than now, which hypothesis seems tenable.

The main direction of the principal mountain masses in the large islands—Porto Rico, Santo Domingo, Cuba (and Jamaica ?)—is such that it places no great strain upon the imagination to conceive of them all having formerly been one continuous system. The ocean straits between these three islands are all narrow, and they are not of such a nature that their permanence throughout the Tertiary is indisputable. Vaughn (1919) discusses the submarine topography as follows:

> Depths of about 1,000 fathoms or somewhat more are found between Cuba and Haiti in the Windward Passage, and between Anegada and Anguilla in the Anegada Passage, but they are usually less than 500 fathoms (p. 598).
>
> As the maximum depth between Haiti and Porto Rico is about 318 fathoms, they rise from a common, not greatly submerged bank (p. 602).
>
> A submarine bank extending from the east end of Porto Rico to Anegada Passage is known as Virgin Bank. The depth of water between the islands rising above this bank is less than 20 fathoms, which is a minimum for the amount of submergence they have recently (geologically speaking) undergone. These islands are detached outliers of Porto Rico.
>
> *8b. Saint Croix.*—Although St. Croix is separated from the Virgin Islands by a depth as great as 2,400 fathoms and is joined to the St. Christopher chain by a ridge less than 1,000 fathoms deep, it possesses great similarity to members of the Virgin group. The west end is truncate and the submarine slope precipitous; the submarine slope to the north is also steep. There is clear evidence of faulting on the west and north sides. A ridge, largely of igneous rock, stands against the north shore from the west end of the island for some distance to the east. South of the ridge is a sloping, rolling, calcareous plain. The east end has a submarine continuation in a bank less than 50 fathoms deep. The tectonic axis is east and west, the rocks resemble those of the Virgins, and the zoogeography indicates former connection with them. For these reasons it seems probable that this island was formerly a part of the Porto Rican-Virgin Island land-mass and has been sundered from it by diastrophic processes. However, Saint Croix might be accorded separate status as a province, or referred to the St. Christopher axis; but it appears to me preferable to classify it with the Virgin Islands (p. 603).

Willis (1910, p. 225) states:

> In the West Indian region the close of the Oligocene period was marked by a notable disturbance, which raised a folded mountain chain from Puerto Rico to Cuba and probably continuously to Yucatan. It may also have closed the Isthmus of Tehuantepec and possibly have temporarily connected Honduras with South America. Another possible line of connection is around the eastern end of the Caribbean through the Windward Islands. If, however, such a land link united North and South America it was but temporary.

Many such statements by eminent geologists and geographers could be quoted here to the same effect as the above. The geological evidence, therefore, interposes no great obstacle in the way of a land connection between Central America and the Greater Antilles.

An elevation of the land of about 1,000 fathoms would unite the Greater Antilles into one continuous land-mass. There is a correlation between the faunas as we find them today on the respective islands and between the various marine formations, which strongly indicates that these islands actually were connected with one another in mid-Tertiary time. The presence of the fossil genera *Nesophontes* on Porto Rico and Cuba, of related genera of fossil ground-sloths on Porto Rico and Cuba, of *Brotomys* on Santo Domingo, and the closely related *Boromys* on Cuba, as well as a number of significant relationships between the living bats found on these islands, denote a distribution which can scarcely be accounted for on any other hypothesis. The mammalia of Jamaica is sufficiently aberrant in many details to warrant the assumption that it was probably split off from the main Antillean continent, if such existed, before the other three islands were broken apart.

The mammal fauna of the entire Antillean area may be classified under three distinct categories. The first group includes the Chiroptera, which are more or less widely distributed throughout the Greater and Lesser Antilles. As factors bearing upon the origin of the Antilles, the distribution of bats must be interpreted with the same reservations as apply to that of birds or of other winged forms of life. The second category comprises land mammals whose affinities are so obviously with present-day mainland forms that they may be classified as waifs or strays from the mainland within comparatively recent times, possibly through the agency of man. The third group is made up of forms, largely fossil, whose relationships are not so immediate, pointing to a remote separation from mainland stock. This third group includes such mammals as *Solenodon*, *Nesophontes* and the large fossil rodents *Amblyrhiza, Elasmodontomys, Clidomys,* etc. It is this third group which has the most profound bearing upon the problem we are discussing.

It is well known that native peoples may transport, either as pets or as food, various forms of smaller mammal life. The presence of *Isolobodon* in kitchen-middens in the Virgin Islands, in Porto Rico and in Santo Domingo indicates that the Arawaks probably carried this animal from place to place in their canoes. The presence of the opossum, the armadillo, the aguti, the rice-rat and the raccoon in the Lesser Antilles, and the deer and rice-rat in the Greater Antilles, is of unquestionably recent introduction, since they differ but slightly from mainland species or may even, as in the case of deer on Cuba, have been introduced within historical time. Instances such as these are of no especial significance in their bearing upon the origin of the Antilles, unless it may be argued that as a waif fauna they represent the incipient stages through which the more distinct island forms may have passed.

There are only two ways in which it seems at all practicable to account for the presence of terrestrial mammals on the Antilles. The first, and to my mind the only, way to account for their presence is to assume that they passed over to the islands on a dry-land connection. The other hypothesis would involve the transportation of these mammals to the islands on life-rafts, which are floating masses of tangled vegetation, such as have been found at a considerable distance at sea off the mouth of the Amazon, Orinoco and other large rivers. Living animals have been noted on these life-rafts after the rafts have been many days at sea, and it is a well-established fact that life may be transported, to some extent at least, in this way. But obstacles in the way of transporting the Antillean fauna on life-rafts seem to be insurmountable. After a fairly extensive experience with conditions as they exist today in the Greater Antilles, it is difficult for me to believe that the terrestrial life which we have found on these islands can have all been brought from some part of the continental mainland by such hazardous methods of transportation.

Dr. Matthew (1915, p. 206) has given the best exposition of the life-raft theory in its relation to the West Indian fauna, and in later papers (1916, p. 11; 1919, p. 161) discusses the arguments for fortuitous distribution. Dr. Barbour (1916) has pointed out some of the obstacles which prevent him from accepting the hypothesis. To any one who has experienced the heat and vigor of the tropical sun and has seen the inhospitable nature of most of the Antillean coast-line, the odds appear overwhelmingly against the successful transportation of such highly organized forms as mammals from some point at the mouth of a great South American river to a safe landing, hundreds of miles from that point, upon an alien shore, and the consequent final establishment of the species.

On the other hand, the occupation of the islands over a mainland connection should have given a much more varied and extensive mammalian fauna than we know today. The known fauna comprises only insectivores, edentates, rodents and bats, leaving out of consideration the obviously recent arrivals. Groups of major importance upon the mainland, such as ungulates, carnivores, lagomorphs and the primates, are entirely wanting in the Antilles and their non-appearance in the Antillean fauna, if it is continental in origin, seems most strange. It might be suggested in partial explanation of this apparent absence, first, that exploration of the Antilles may yet disclose the presence of some of these groups, since the field for research is very extensive and has been by no means exhausted; second, that the Antilles as they exist today not only may, but probably do, represent the elevated portions of a now submerged, greater land-mass. Plains types, which include many of the ungulates, lowland forms such as primates, and the larger carnivores preying upon these two groups may never have ranged at sufficiently high elevations to have been brought into the area now above water. Had they existed on a former Antillean continent they might be preserved today in formations under the sea. This admittedly weak argument might explain the absence of certain larger mammals, but will hardly suffice for the non-appearance of the smaller representatives, which would be expected to range wherever the rodents and edentates could go.

The absence of dominant mainland types in the Antilles and the restricted variety of the fauna is summarized by Matthew (1918, p. 665).

> As to the former connection of the Antilles with each other and with the mainland, my conclusions with the proviso just stated are as follows:
>
> 1. That the Greater Antilles have probably been united with each other, as far east as the Anguilla bank, in the late Tertiary or Pleistocene. This I conclude from the near affinity of representative species of the same or closely allied genera and the general similarity of the fauna, so far as known, in the different islands.
>
> 2. That they have not at any time during the Tertiary been united with North America. If they had been we should find North American ungulates, rodents, carnivores, etcetera, differentiated in accord with the length of subsequent isolation, but of clearly recognizable affinities, and it would be a balanced or representative fauna. We might object that such a fauna had perhaps existed, but been wiped out by subsequent submergence. But the presence of *Solenodon* and *Nesophontes* negatives that, for they represent a very ancient survival, and if there had been a representative fauna it is hardly credible that submergence would have spared just two insectivores and destroyed all the rest of the fauna.
>
> 3. That they probably have not been connected with South America, either via the Lesser Antilles or via Central America, during the Tertiary; for if they had the fauna should be of continental South American type, with South American ungulate groups, marsupial carnivores, and a full representation of the rodents, edentates, etcetera.
>
> 4. The mammalian fauna appears to me to be reducible to perhaps three primary rodent stocks, one or more primary ground-sloth stocks, and two Insectivora. These I conceive to have arrived at various times during the Tertiary, the rodents and ground-sloths from South or Central America, the insectivores from North America, by accidents of transportation, of which the most probable for the mammals would perhaps be the so-called “natural rafts”

> or masses of vegetation dislodged from the banks of great rivers during floods and drifted out to sea. The probabilities of this method I have elsewhere discussed. For birds and bats, for the smaller reptiles, amphibians, fishes and invertebrates, the problem of oversea transportation is a much simpler one. That successful colonization in this way can occur is shown by their presence on nearly all oceanic islands; for it will hardly be maintained by reasonable men that every oceanic island has been joined to the mainland and has been continuously above water since its separation. Obviously, the larger the island and the nearer to continental land, the more often such colonization will occur.

With few exceptions, the affinities of the Antillean mammals appear to be South American. Among the bats, only a few forms are of genera or species essentially North American. Most of the groups are related to forms found in Central and South America, the present-day Central American distribution of these particular forms seeming to have been derived by migration from the South. G. M. Allen (1911, p. 179) has discussed at some length the affinities and origin of the Chiroptera of the West Indies.

The insectivores, *Solenodon* and *Nesophontes,* are probably of North American origin. The only insectivore known from South America, apart from the very recent invasion of the shrews into northern South America, is the fossil *Necrolestes* from the Santa Cruz formation of Patagonia, with which the Antillean insectivores have nothing in common. The zalambdodont *Palaeoryctes* has been found in the Basal Eocene of North America and may possibly have had affinities with an ancestral *Solenodon.* Nothing has been found in North American formations to which *Nesophontes* may be said to be closely related; but, due to absence of Insectivora in South American formations, it is to the North American fields that one would most logically turn for an ancestral nesophontid.

That these two insectivores typify two separate and distinct families endemic to the Greater Antilles can not be taken as an *ipso facto* argument for extreme antiquity of arrival from the mainland. While it is true that the forms most like *Solenodon* and *Nesophontes* are not found later than Eocene and Oligocene in North America, it does not necessarily follow that the island insectivores invaded the Antilles at that time or prior to it. These primitive creatures *may* have arrived during the Miocene, or whenever it was that the hystricomorph rodents took possession, and I think it unlikely that distinctive family characters have been acquired by insular isolation; these characters the animals had when they left the mainland. The fossil records of Insectivora are so scanty and the Central American field has been so little explored for any fossil mammals that such negative evidence as the absence of related fossil insectivores on the mainland after Eocene and Oligocene times should be discounted in estimating the time of arrival of the Antillean mammals.

The rodents of the Antilles are all hystricomorph (dismissing again from the discussion the recently transported *Oryzomys* and the cricetine *Megalomys*), and here the affinities are all with South American forms. The genera displaying the best evidence of a long separation from the mainland stock are *Amblyrhiza, Elasmodontomys, Heptaxodon, Clidomys, Spirodontomys, Speoxenus* and *Alterodon*. *Amblyrhiza* and *Elasmodontomys* find their closest counterparts in *Megamys* and *Tetrastylus* of the Entrerian of South America and in *Dinomys*, a living South American representative of the family. The relationships of the other genera are not so clear; but, inasmuch as the hystricomorphs were a flourishing group in South America during the Tertiary, it seems most likely to assume that they came from there. Another assemblage of the rodents includes *Heteropsomys, Homopsomys, Plagiodontia, Isolobodon, Aphaetreus, Ithydontia, Boromys, Brotomys, Capromys* (including the subgenus *Geocapromys*), and these are all of undoubted South American affinities, although not very immediately related to any of the Echimyinae known on the continent today.

The distribution of *Geocapromys* presents an interesting problem because of its discontinuity. There are three living species known—one from the Plana Keys in the Bahamas, one from Jamaica, and the third from Little Swan Island just off Honduras. A fourth species is known from Cuba as a fossil.

A presumably ancestral capromid, *Procapromys geayi*, has been described from the mountains of northern Venezuela by Pousargues (1899, p. 150). So far as I am aware, no additional specimens of this animal have been taken since its description, and I am loath to use its supposed nativity on the mainland and its affinity to the Antillean *Capromys* as evidence until we have more data. The type and only specimen of *Procapromys geayi* may have been carried to the mainland from the Antilles. Indeed, Pousargues himself considered this to be a possibility until he became convinced that the animal was mature and distinct from known island species. The small size of the type of *Procapromys* and the slightly worn molars strongly indicate juvenility, because in this group the full adult dentition comes early in life. There is nothing in Pousargues' description, apparently, which would not fit an immature *Capromys pilorides*, for example. In fact, a specimen of this species, No. 41052, collected by me in eastern Cuba, seems to be indistinguishable when compared with the figures given by Pousargues. The assumption that the Antillean genus *Capromys* has a close relative on the Venezuelan mainland has been used as one of the arguments for a continental connection through the Lesser Antilles.

I am disposed to believe that the Antillean land-mass was not connected to South America through the Lesser Antilles, and that it is unnessary to use such a hypothesis to account for the Antillean mammal fauna. The absence of truly Antillean mammalia throughout most of the Lesser Antilles, the volcanic nature of many of these islands, and the better agreement of the facts in general with the hypothesis of a Central American connection are all arguments against a functional land-bridge through the Lesser Antilles. In just how far a land-bridge may have functioned, the present distribution of mainland types on the Lesser Antilles is taken as evidence.

No one will dispute the continental origin of Trinidad, with its comparatively rich continental fauna. The submarine topography from the Windward Islands south to Venezuela would seem to favor equally well a mainland connection anywhere from Trinidad to Guiana.

Agassiz (1888, Vol. I, p. 99) states:

> The eastern boundary of the Eastern Caribbean is formed by the dumb-bell shaped plateau, from which rise the Windward Islands (Fig. 58). These extend in a gigantic arc from Sombrero and Santa Cruz to Grenada, Tobago, and Trinidad, leaving broad, shallow passages between the islands to the north of Dominica, with the three comparatively deeper straits separating Dominica, Martinique, St. Lucia, and St. Vincent. We next come to the still shallower passages over the Grenadines Bank, and the deeper passage between that bank and Tobago. This island, as well as Trinidad, and all the Leeward Islands to the north of Venezuela, lie within the hundred-fathom line. They are all only outposts of the South American continent. From the Gulf of Venezuela to the mouth of the Orinoco the hundred-fathom line is about ninety to one hundred and twenty miles from the South American coast.

A fissure 12,000 feet deep which cuts in from the Caribbean to the Gulf of Paria may indicate that the Antillean contact with the mainland was east of this cleft. However, the exact point of contact is immaterial. and once we have started northward along the Windward Islands the course of the hypothetical bridge is apparent. Tobago has a fauna akin to that of Trinidad, continental in its affinities, but not so extensive by far. The mainland invasion then loses most of its force and only a few scattered representatives go north of Tobago. Such mammals as *Dasyprocta, Didelphys, Marmosa, Procyon* and *Megalomys* appear here and there. But this distribution is so desultory and the mainland affinities are so apparent that many of these records must be suspected as the results of fortuitous transportation.

It is interesting to note the character of this fauna which has been distributed by "flotsam and jetsam" methods. The advocates of fortuitous distribution throughout the Antilles have pointed to the scarcity of types represented as evidence of waif distribution. In the Lesser Antilles we note that, in this case at least, a waif fauna is rather inclusive, since it takes in a wide variety of types and two large groups, the marsupials and carnivores, which are not found in the Greater Antilles. The apparent selection of the types known in the Greater Antilles seems to imply something more than blind chance, which, we can observe in the Lesser Antilles, distributes without partiality, physical size alone proving to be a factor.

No mammals (exclusive of bats) properly to be considered as endemic to the Antilles are encountered until we pass out of the Windward Islands, through most of the Leeward Islands, and enter an area which is apparently to be associated with the Greater Antillean area. Here *Amblyrhiza* occurs fossil on St. Martins and on Anguilla, the northernmost of the Leewards. Therefore, it seems reasonable to assume, from the distribution of the mammals throughout the Lesser Antilles, that these islands had no continuous land connection to South America north of Tobago since the time that the present continental fauna has developed, and, furthermore, that there has been no such connection in mid-Tertiary time.

The facies of the mammalian distribution in the Greater Antilles shows that the problem here is quite distinct from that in the island chain to the south. In the assemblage of forms which are found in the region from Anguilla to Little Swan, all of the terrestrial mammals (except *Oryzomys* and *Odocoileus*) and many of the bats are so distinct in affinity from continental species, genera, and even families, in some cases, one can not escape the conclusion that we have to deal with the remnants of a subcontinental fauna derived from the mainland at some Tertiary period.

The presence of *Capromys* (*Geocapromys*) *thoracatus* on Little Swan Island close to Honduras has been frequently used by writers as an argument for a continental connection between Jamaica and Honduras. No species of *Capromys* is known to occur in Central America today, and hence *thoracatus* can be no modern waif from Honduras. On the other hand, Jamaica is the home of a closely related species, ***brownii,*** of the same subgenus. Other terrestrial mammals on Jamaica, fossil hystricomorph rodents, are quite distinct from the fossil hystricomorphs of Cuba, Haiti, Porto Rico and Anguilla. If the only mainland connection to the Antilles was by way of Jamaica, one could expect to find the larger islands having some of these peculiar hystricomorphs in common with

Jamaica, at least as closely related genera. The explanation here, as pointed out earlier in this discussion, is to assume an early separation of Jamaica from the other large islands and a subsequent divergence in the evolution of the respective faunas.

It is not unlikely that the Antillean fauna arrived over two continental contacts, established possibly simultaneously, but more probably at different times. This hypothesis would explain the edentates and insectivores on Cuba, Haiti and Porto Rico and their absence on Jamaica, and the difference between the hystricomorph rodents on Jamaica and the other large islands. If the evidence seems sufficient to postulate two land-bridges to Central America, it would be unnecessary to argue for fusion of Jamaica with the Antillean subcontinent, since the distribution of the island mammalia can be explained without such fusion. If the mammals were rafted to the Greater Antilles and no land connections existed, it seems strange that the rafts distributed the various forms, restricted in variety though they be to the three orders, in proper geographical regions to conform to a subcontinental distribution. If the exponents of the raft theory concede a former fusion of the Greater Antilles into a subcontinent, their case can claim little geological support, since the same elevation which united the islands raises the bridges to the mainland. After such an admission, the strongest evidence against a land connection from Central America to the united island mass is the restricted nature of the fauna.

The fundamental relationships between the Antillean and the continental mammal faunas may be shown best, perhaps, by a table listing the entire mammalia of the Antillean region, but omitting the unquestioned introductions (*Odocoileus, Mungos,* etc.). In this list Haiti is used collectively as the name for the entire island which comprises the Republic of Haiti and the Republic of Santo Domingo. The Bahamas are not all included in the geographical region covered by the list, since they are, for the most part, of recent formations. Some of them may have been associated with the Antilles in a former land-mass; but, since their fauna is so scanty and the question of continental connections stands or falls upon the evidence secured in the Antilles, it simplifies matters somewhat to omit the Bahamas.

Forms Found in Greater Antilles and Virgin Islands, East to Anguilla[15]

	EDENTATA			
1.	Megalocnus rodens	Cuba	—fossil	Genera endemic to Cuba, monotypic—affinities with forms which predominated in the Miocene of South America and some of which reached North America in Pleistocene.
2.	Microcnus[16]			
3.	Mesocnus			
4.	Miocnus			
5.	Acratocnus odontrigonus	Porto Rico	—fossil	Genus endemic to Porto Rico—affinities with *Megalocnus* and Miocene of South America.
6.	" major			
	RODENTIA			
7.	Amblyrhiza inundata	Anguilla, St. Martins	—fossil	Genus endemic to West Indies, monotypic—affinities with Dinomyidae of South America—Miocene to Recent.
8.	Elasmodontomys obliquus	Porto Rico	—fossil	Genus endemic to Porto Rico, monotypic—affinities with Dinomyidae.
9.	Clidomys osborni	Jamaica	—fossil	Genera endemic to Jamaica—affinities with Dinomyidae—latter two genera monotypic.
10.	" parvus			
11.	Spirodontomys jamaicensis			
12.	Speoxenus cundalli			
13.	Alterodon major	Jamaica	—fossil	Genus endemic to Jamaica, monotypic—affinities to Octodontinae? of South America—Oligocene to Recent.
14.	Capromys pilorides pilorides	Cuba	—living	Genus endemic to West Indies—affinities with Echimyinae of Tropical America—Miocene to Recent.
15.	" " relictus	Isle of Pines, Cuba	—living	
16.	" prehensilis prehensilis	Cuba	—living	
17.	" " gundlachi	Isle of Pines, Cuba	—living	
18.	" melanurus	Cuba	—living	
19.	" nana	Cuba	—living	
20.	" (Geocapromys) brownii	Jamaica	—living	
21.	" " thoracatus	Little Swan Island	—living	
22.	" " ingrahami	Plana Key, Bahamas	—living	
23.	" " columbianus	Cuba	—fossil	

24. Plagiodontia aedium	Haiti	—living?	Genus endemic to Haiti, monotypic—affinities with Echimyinae.
25. Isolobodon portoricensis	Porto Rico, Haiti, St. Thomas, St. Croix.	—fossil	Genus endemic to West Indies, monotypic—affinities with Echimyinae.
26. Aphaetreus montanus	Haiti	—fossil	Genera endemic to Haiti, monotypic—affinities with Echimyinae.
27. Ithydontia levir	Haiti	—fossil	
28. Brotomys voratus	Haiti	—fossil	Genus endemic to Haiti, monotypic—affinities with Echimyinae.
29. Boromys offella	Cuba	—fossil	Genus endemic to Greater Antilles—affinities with Echimyinae.
30. " torrei	Cuba	—fossil	
31. Heteropsomys insulans	Porto Rico	—fossil	Genera endemic to Porto Rico, monotypic—affinities with Echimyinae.
32. Homopsomys antillensis	Porto Rico	—fossil	
33. Oryzomys* antillarum	Jamaica	—exterminated in last century	Species apparently endemic to Jamaica, but a recent arrival from Central America nevertheless.
INSECTIVORA			
34. Nesophontes edithae	Porto Rico	—fossil	Genus endemic to Greater Antilles—affinities with North America, but very ancient.
35. " micrus	Cuba	—fossil	
36. " longirostris	Cuba	—fossil	
37. Solenodon paradoxus	Haiti	—living	Genus endemic to Greater Antilles—affinities with North America, but very ancient.
38. " cubanus	Cuba	—living	

[15] It seems logical, upon the evidence, to assume that the Greater Antillean area reached as far east as Anguilla and St. Martins. However, the presence of the deep Anegada Passage between the Virgins and Anguilla and St. Martins may well call for comment on the soundness of such a grouping. The biological data is given precedence over this geological obstacle, and if the Anegada Passage is the result of block-faulting its existence throughout mid-Tertiary times may well be questioned.

[16] Dr. W. D. Matthew (1918, p. 660, and 1919, p. 168) has given a short, provisional description of these three genera related to Megalocnus.

Forms Found in Greater Antilles and Virgin Islands, East to Anguilla—Continued

	CHIROPTERA			
39.	Noctilio leporinus mastivus	St. Croix, Porto Rico, Mona, Jamaica, Cuba.	—living	Subspecifically distinct from continental forms—a recent arrival from Tropical America.
40.	Chilonycteris macleayii	Cuba	—living	Species endemic to Greater Antilles—affinities with species in Tropical America.
41.	“ fuliginosa fuliginosa	Haiti	—living	
42.	“ “ inflata	Porto Rico	—living	
43.	“ “ grisea	Jamaica	—living	
44.	“ torrei	Cuba	—living	
45.	“ parnellii parnellii	Jamaica	—living	
46.	“ “ boothi	Cuba	—living	
47.	“ “ portoricensis	Porto Rico	—living	
48.	“ “ pusillus	Haiti	—living	
49.	Mormoops blainvillii	Jamaica, Cuba, Haiti, Mona, Porto Rico.	—living	Species endemic to Greater Antilles—related specifically to forms ranging from southern Texas to northern South America.
50.	Macrotus waterhousii waterhousii	Haiti	—living	Species endemic to Greater Antilles—related specifically to forms ranging from southern United States through Central America.
51.	“ “ jamaicensis	Jamaica	—living	
52.	“ “ minor	Cuba, Isle of Pines	—living	
53.	Vampyrum spectrum	Jamaica	—living	Continental species of tropical distribution.
54.	Glossophaga soricina antillarum	Jamaica	—living	Subspecifically related to widely ranging continental species of tropical distribution.
55.	Monophyllus* redmani	Jamaica	—living	Genus endemic to West Indies—affinities with genera on the mainland of Tropical America.
56.	“ cubanus cubanus	Cuba	—living	
57.	“ “ ferreus	Haiti	—living	
58.	“ portoricensis	Porto Rico	—living	
59.	“ frater	Porto Rico	—fossil	
60.	“ clinedaphus	Unknown but undoubtedly West Indian.	—living	

61. *Carollia perspicillata*	Jamaica	—living	Identical with widely ranging continental species of Tropical America.
62. *Sturnira lilium*	Jamaica	—living	
63. Brachyphylla cavernarum†	Porto Rico	—living	Genus endemic to West Indies—affinities with continental genera ranging throughout Tropical America.
64. " nana	Cuba	—living	
65. " pumila	Cuba	—living	
66. Artibeus jamaicensis jamaicensis‡	Jamaica, Porto Rico, Haiti, Virgin Islands, Anegada, Anguilla, St. Martins.	—living	Subspecifically identical with continental form ranging from northern South America into Central America—see map of distribution of *Artibeus*, page 241.
67. Artibeus jamaicensis parvipes	Cuba	—living	Subspecies endemic to Cuba.
68. Phyllops falcatus	Cuba	—living	Genus endemic to Greater Antilles, species endemic to respective islands—tropical American affinities.
69. " haitiensis	Haiti	—living	
70. " vetus	Cuba	—fossil	
71. Ariteus flavescens	Jamaica	—living	Genus endemic to Jamaica, monotypic—tropical American affinities.
72. Stenoderma rufus	Porto Rico	—living?	Genus endemic to Porto Rico, monotypic—tropical American affinities.
73. Phyllonycteris major	Porto Rico	—fossil	Genus endemic to Greater Antilles—tropical American affinities.
74. " poeyi	Cuba	—living	
75. Erophylla bombifrons	Porto Rico	—living	Genus endemic to Greater Antilles and to Bahamas—tropical American affinities.
76. " santacristobalensis	Haiti	—living	
77. " sezekorni	Cuba	—living	
78. " syops	Jamaica	—living	
79. Reithronycteris aphylla	Jamaica	—living	Genus endemic to Jamaica, monotypic—tropical American affinities.
80. Natalus* major	Haiti	—living	Related specifically to forms of Neotropical mainland.
81. " primus	Cuba	—fossil	

Forms Found in Greater Antilles and Virgin Islands, East to Anguilla—Continued

82. Chilonatalus macer	Cuba	—living	Genus endemic to West Indies and Bahamas—two other species known from Old Providence and Watling Island—tropical American affinities.
83. " micropus	Jamaica	—living	
84. Nyctiellus lepidus	Cuba	—living	Genus endemic to Cuba, monotypic—tropical American affinities.
85. Eptesicus fuscus cubensis	Cuba	—living	Related subspecifically to species with range from North to South America. Genus cosmopolitan in distribution.
86. " " wetmorei	Porto Rico	—living	
87. Nycteris borealis pfeifferi	Cuba, Jamaica	—living	Related subspecifically to widely ranging form of North and Tropical Americas.
88. Nycticeius cubanus	Cuba	—living	Closely related to species ranging throughout southeastern United States.
89. Tadarida* murinus	Porto Rico, Cuba, Haiti, Jamaica.	—living	Closely related to species found widely distributed throughout Tropical America.
90. Tadarida* macrotis	Jamaica, Cuba	—living	Related to continental species, found in Tropical America—genus distributed throughout warmer regions of the world.
91. Mormopterus minutus	Cuba	—living	Species endemic to Cuba, only other species of genus known in the Western Hemisphere is found in Peru. Genus occurs in southeastern Africa, Madagascar, Bourbon and Mauritius.
92. Eumops glaucinus	Cuba	—living	Specifically identical with a continental form which ranges from Brazil to Central America.
93. Eumops orthotis	Jamaica	—living	Closely related to, if not identical with, *glaucinus*.

94. Molossus* fortis	Porto Rico	—living	Closely related *inter se* and to mainland forms ranging throughout Tropical America.
95. " fuliginosus	Jamaica	—living	
96. " verrilli	Haiti	—living	
97. Molossus* tropidorhynchus	Cuba	—living	Related to species of Central and South America.

* Genus found also in Lesser Antilles.
† Species found also in Lesser Antilles.
‡ Subspecies found also in Lesser Antilles.

Forms Found in Lesser Antilles

MARSUPIALIA			
1. Didelphys marsupialis insularis	Dominica, St. Vincent, Grenada.	—living	Recent arrival from South America.
2. Marmosa chapmani	Grenada	—living	Recent arrival from South America.
EDENTATA			
3. Dasypus novemcinctus hoplites	Grenada	—living	Recent arrival from South America.
RODENTIA			
4. Dasyprocta albida	St. Vincent	—living	Recent arrival from South America.
5. Dasyprocta antillensis	St. Lucia	—living	Recent arrival from South America.
6. Dasyprocta noblei	Guadeloupe	—living	Recent arrival from South America.
7. Echimys armatus	Martinique	—living	Recent arrival from South America.
8. Oryzomys* victus	St. Vincent	—living?	Recent arrival from South America.
9. Megalomys desmarestii	Martinique	—extinct?	*Megalomys* considered by Major to be indistinguishable from *Oryzomys*.
10. Megalomys luciae	St. Lucia	—extinct?	

Forms Found in Lesser Antilles—Continued

CARNIVORA			
11. Procyon minor	Guadeloupe	—living	Recent arrival from Tropical America.
CHIROPTERA			
12. Peropteryx canina phaea	Grenada	—living	Recent arrival from South America.
13. Noctilio leporinus mastivus‡	Grenada, St. Lucia, St. Vincent, Guadeloupe, Antigua.	—living	Recent arrival from South America.
14. Pteronotus davyi davyi	Dominica	—living	Subspecifically identical with South American form.
15. Glossophaga longirostris rostrata	Grenada, the Grenadines.	—living	Subspecifically related to continental species of South American distribution.
16. Monophyllus* plethodon	Barbados	—living	Genus endemic to Antilles.
17. " luciae	St. Lucia	—living	
18. Sturnira lilium	Dominica	—living	Identical with widely ranging continental species of Tropical America.
19. Brachyphylla cavernarum†	St. Vincent	—living	Genus endemic to Antilles—affinities with continental genera ranging throughout Tropical America.
20. " minor	Barbados	—living	
21. Artibeus jamaicensis jamaicensis‡	St. Kitts, Antigua	—living	Identical with subspecies ranging through Central America and northern South America.
22. Artibeus jamaicensis palmarum	St. Vincent	—living	Identical with subspecies ranging through Central America and northern South America.
23. Artibeus jamaicensis praeceps	Guadeloupe, Dominica	—living	Subspecies endemic to Guadeloupe and Dominica.

24. Artibeus planirostris grenadensis	Grenada	—living	Subspecies endemic to Guadeloupe and Dominica.
25. Ardops annectens	Guadeloupe	—living	Genus endemic to Lesser Antilles, species endemic to respective islands—affinities with several endemic genera of the Greater Antilles and less closely with genera of tropical mainland.
26. " luciae	St. Lucia	—living	
27. " montserratensis	Montserrat	—living	
28. " nichollsi	Dominica	—living	
29. Natalus* stramineus	Dominica	—living	This same species ranges through northern South America and Central America.
30. Myotis dominicensis	Dominica	—living	Related specifically to widely ranging species of North and South America. Genus cosmopolitan in distribution.
31. Tadarida* antillularum	Dominica, St. Kitts, St. Bartholomew, Montserrat, St. Lucia.	—living	Closely related specifically, if not subspecifically, to widely ranging forms found from southern North America through Central America into South America.
32. Molossus* major	Martinique, Dominica	—living	Closely related to *fortis*, *fuliginosa* and *verrilli* of Greater Antilles.
33. " debilis	St. Kitts, Nevis, Antigua, Montserrat.	—living	
34. " obscurus	Barbados, St. Lucia	—living	

* Same genus found in Greater Antilles.
† Same species found in Greater Antilles.
‡ Same subspecies found in Greater Antilles.

Ninety-seven species and subspecies of mammals are known from the Greater Antillean area. These forms are comprised in four orders, some fifteen families and fifty genera. Of the ninety-seven species and subspecies, only fourteen are identical with or immediately related to species found on the continents of North and South America. Eighty-three forms are endemic to the Antilles, either specifically or generically. Thirty genera are autochthonous in the Greater Antilles, exclusive of two genera autochthonous in the West Indies (used in the large sense). Both families of the Insectivora are endemic to the Greater Antilles, and all of the edentates and hystricomorph rodents of the Greater Antilles are so distinct from mainland genera that calling attention to them as autochthonous genera scarcely suffices; doubtless some of the distinctions should warrant subfamily separations. The outstanding feature of the mammalia of the Greater Antilles is its endemic nature.

Thirty-four species and subspecies of indigenous mammals are known to occur in the Lesser Antilles, representing twenty-one genera, sixteen families and subfamilies and five orders. Of these thirty-four species and subspecies, twenty-four species and subspecies are either identical with or very closely related to species and subspecies living in Central and South America. Of the remaining ten forms, two (the species of *Megalomys*) are of undoubted recent arrival from the mainland (I have not seen this genus, but feel certain that it is closely related to *Oryzomys,* as stated by Major, 1901, p. 205) and eight are members of genera endemic to the Antilles. There is one autochthonous genus in the Lesser Antilles (with the possible exception of *Megalomys*), *Ardops;* no species of *Ardops* has been found, either on the mainland or in the Greater Antilles. The evolution of four distinct species of *Ardops* on as many islands of the Lesser Antilles points toward an early arrival of the ancestral form and also is a bit of evidence to show that some species of bats do not pass back and forth freely between islands separated by a few miles of sea-water.

It might be urged that a given form does or does not typify an endemic genus, accordingly as the worker restricts or enlarges his concept of a genus. The classification of the Antillean mammalia followed in this discussion is that of the majority of mammalogists and grants extensive limits to the genus concept. Furthermore, the same classification holds for the Lesser as for the Greater Antilles, and it is impossible to avoid the conclusion that the mammals of the Greater Antilles have been longer separated from mainland stock than have those of the Lesser Antilles, and also that there has been comparatively little migration of forms from the one group of the Antilles to the other.

No less than twenty of the thirty autochthonous genera of the Greater Antilles are monotypic, and this fact has bearing on the apparently restricted dispersal of types in recent times and hints at either a polyphyletic origin of the mammalia in earlier times, a very ancient separation of the respective islands, or a very rapid rate of differentiation. In each case, the individuals of the monotypic genus have been restricted to one island. Whenever one of the endemic genera is found indigenous on two or more islands specific differentiation is seen.

Thus far in this discussion the zoölogical comment has been based solely upon the nature and distribution of the mammalia in the Antilles and any hypothesis advanced has been postulated upon zoölogical evidence entirely mammalian. The distributions of other forms of life, while giving support, in some respects, to other hypotheses, such as a mainland connection to South America through the Lesser Antilles, also corroborate the theories of a former Antillean continent, the connection of this continent to Central America, and the distinction between the faunas of the Greater and Lesser Antillean associations. Chapman (1892 and 1898) points out the high percentage of endemic forms in the avifauna, 90 per cent of the resident land birds being endemic and one family (*Todidae*) and 38 genera peculiar to the West Indies. He goes on to say (1898, p. 245):

> So far as their avifauna is concerned, therefore, there has apparently been no connection between the Lesser Antilles and the mainland, and we may regard these islands as zoölogical dependencies of both South America and the Greater Antilles, from which, through more or less fortuitous circumstances, their avifauna has been derived.
>
> Turning now to the Greater Antilles, we may at once dispose of the Bahamas as oceanic islands of more recent formation than any of the larger islands or mainland adjacent to them, from which they have evidently received their life. Only one genus is peculiar, and with the exception of its single species, the ancestry of the twenty-five forms peculiar to the Bahamas can be traced with more or less certainty, Cuba furnishing the greater number of parent forms. The Caymans, about 175 miles south of Cuba and 200 miles west of Jamaica, present an apparently similar case, most of the fifteen forms peculiar to them being closely related to Cuban or Jamaican species.
>
> We have left now the four larger islands of the Greater Antilles, from which 174 of the 303 peculiar West Indian birds have been recorded. They are distributed as follows:
>
> Jamaica, 66, of which 42 are endemic; Cuba, 68, of which 45 are endemic; Haiti and San Domingo, 56, of which 34 are endemic; Porto Rico, 46, of which 25 are endemic.

And again (1892, p. 325):

> It will be observed that although Jamaica is but little larger than Porto Rico, and is more isolated from neighboring regions than any island of the

> group, it is nearly as rich in endemic species, and has one more peculiar genus than Cuba. The latter island is not only ten times as large as Jamaica, but its proximity to Florida has given it at least four forms which have evidently been derived from Florida species. They are *Colinus virginianus cubanensis*, *Campephilus bairdi*, *Colaptes chrysocaulosus*, and *Sturnella hippocrepis*. Hayti, although about seven times as large as Jamaica, has eight endemic species less, while Porto Rico, nearly as large as Jamaica, and favorably situated for the reception of Lesser Antillean species, has seventeen endemic species less than Jamaica, and but one genus is peculiar to the island.
>
> It is evident that, as Wallace (1876, p. 66) has said, the islands "were not peopled by immigration from surrounding countries while in the condition we now see them, for in that case the smaller and more remote islands would be very much poorer, while Cuba, which is not only the largest, but nearest to the mainland in two directions, would be immensely richer, just as it really is in migratory birds."

Chapman concludes (1892, p. 326):

> While there is little ground, therefore, for the hypothesis of an Antillean continent, it is not impossible that the land connection I have just outlined between Central America and Jamaica may have existed. That there has been a closer connection between this island and the mainland both the disproportionately rich avifauna of Jamaica and the shallowness of the intervening sea give us good reason to believe, but that the island has ever been completely joined to the mainland there is abundant room for doubt; first, because of the scarcity of terrestrial mammalia in the West Indies; second, because of the restrictions of the avifauna.

Since the above was written, there have been notable additions to the mammalia known from the West Indies, and consequently Chapman's first argument against a mainland connection to Jamaica loses some of its force. A not inconsiderable addition to the avifauna has been made as well, and such discoveries as a resident White-winged Crossbill in Haiti has opened new lines of speculation.

Chapman writes (1917, p. 332):

> Dr. Abbott's discovery that a race of the White-winged Crossbill inhabits the pine forests of the higher mountains of Santo Domingo is one of the ornithological sensations of recent years.
>
> If the bird were a Red Crossbill, its presence, even in a West Indian island, would not be so surprising. This latter species nests as far south as the Alleghanies of northern Georgia, and its accidental occurrence in the Bermudas proves its ability to reach an island well removed from the nearest mainland.
>
> The White-winged Crossbill is not known to nest south of northern New York, and, even in winter, it has not been recorded from south of Virginia. Its fortuitous occurrence in the West Indies is, therefore, not now to be expected. Nor does it seem probable that, under existing climatic conditions.

> a bird of the Canadian Zone would thrive in the tropics, even at an altitude of 4,000 feet, if introduced there.
>
> If this be true, it follows that *Loxia* has adapted itself to life in the Subtropical Zone through, not a sudden, but a gradual climatic change. Such a change we know to have accompanied the wane of the last Glacial Period. Perhaps, therefore, we are warranted in assuming that the climatic conditions which brought the Musk Ox to Kentucky, the Walrus to the vicinity of Charleston, South Carolina, and the Great Auk as far south as Ormond, Florida, are also responsible for the original occurrence of the White-winged Crossbill in Santo Domingo.
>
> The pines which had preceded it, and which may also be considered as boreal invaders, forced southward by the Ice Age, offered the food supply the bird's habits require, and in its insular home it has been stranded after the causes to which its presence is due have disappeared.
>
> It is not implied that the existence of *Loxia* in the greater Antilles indicates a land connection between these islands and the southeastern United States. We have seen that the Red Crossbill is of recent occurrence in Bermuda, and it is therefore well within the bounds of probability to believe that during the time when the Glacial Period forced the White-winged Crossbill far below its present range in North America, it might have occurred fortuitously in Santo Domingo.

This assumption by Chapman, that the southern advance of the ice sheet in North America may have produced such profound climatic changes in the Antilles that boreal visitors found an acceptable home there, suggests as a corollary the extinction or driving southward of tropical forms in the Antilles which could not withstand boreal conditions. The poverty of the present-day non-volant mammalia may be, in part, explained by such an assumption and the extinction of the greater part of the fossil mammalia may have been contemporaneous with the Glacial Period. While there is nothing in this assumption to conflict with the distribution of the mammalia in the Antilles, I leave to the students of the other classes of zoölogy the determination as to whether or not this idea is compatible with their facts.[17]

The distribution of the reptiles and amphibians best conforms to the hypothesis of a mainland connection. According to Barbour (1919, p. 79),

> The connection, at some time in the past, of Cuba with both Yucatan and Haiti is very strongly indicated by the fauna, not only among the reptiles and amphibians but in very many other groups.

And (1914, p. 236):

> The fauna of the West Indian region as a whole is homogeneous; that is to say, certain genera, as, for instance, *Ameiva*, probably derived from north-

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[17] See Daly, 1915, p. 167, for an account of the far-reaching influence of the great ice-caps.

> eastern South America, have penetrated through the chain with a local species upon practically every island, and reached as far as Cuba and Jamaica. Naturally, the types derived from South America are most abundant in the islands which were last in connection with South America, as in Grenada; and disappear gradually, dropping out one by one, until but comparatively few reach the Greater Antilles. Conversely, types of Central American origin predominate in Cuba and Jamaica; Central American types, derived through both of these islands, occur on Haiti and Porto Rico. Other genera which may be called purely Antillean are found throughout the entire group of islands; and the most characteristic of these are *Alsophis* and *Leimadophis*, whose distributions parallel one another in a most remarkable manner, as does also the distribution of *Eleutherodactylus*. There is no use in expanding upon the limits of extent of the other genera, as these may easily be seen by referring to the tables. The point, however, which is most worthy of emphasis is that this homogeneous fauna is characteristic not only of reptiles and amphibians, but of birds and mammals, as well as of groups of terrestrial invertebrates, *Peripatus* affording an excellent example. When this fact is taken into consideration with the regularity with which the important genera occur on practically every island that has been scientifically explored, with a species peculiar to each, it becomes evident at once that these groups of individuals on each island have been isolated for a long time, and that evolution by isolation would be impossible if individuals were being carried from one island to another by flotsam and jetsam dispersal. The inherent tendency of any isolated group of individuals to vary in some definite direction and to fix peculiar characters within the group would be impossible if a constant exchange of individuals from one island to another were taking place. If this has taken place in the past, it should be occurring still; and the fact that it does not occur now is good proof that this method of dispersal has never played a part of any importance in the past. A very few species have been carried about fortuitously,—whether by human agency or otherwise, it is impossible to know,—but this has been the exception and not the rule. The West Indian fauna is obviously one which has descended from species which formerly ranged over great areas of land which, in connection with each other at various times, as well as with the mainland of Central and South America, have gone to make up the area we may call Antillea.

Barbour (1910, p. 277) also finds that the reptiles and amphibians of Jamaica call for an early separation of Jamaica from Antillea:

> Hydrographically, then, Jamaica is intimately related with both Central America and Haiti, and it seems probable that Lesser Antillean species and Central American species have come through a land connection which had nothing to do with Cuba. This would account, for instance, for the presence of *Aristelliger* in Haiti and Jamaica. The early separation of Jamaica from the mainland and from Haiti would account for the absence of types having such a distribution as *Bufo* and *Amphisbaena*, which may easily have reached Haiti from the mainland of Central America by way of Cuba. For another connection must have existed between Cuba and the upper peninsula of Haiti after the separation of Jamaica from Haiti, and may we not suppose that the

separation took place before the migration of *Bufo* or *Amphisbaena* had extended far enough to have reached Jamaica before it was separated?

Stejneger (1902, pp. 561 and 562) pictures a condition which applies, as I have shown, to the mammals, when he describes the relations and origin of the Porto Rican herpetological fauna.

> In analyzing the composition of the Porto Rican herpetological fauna we find that out of a total of thirty-five species (excluding the marine turtles) no less than twenty-one are peculiar, of which fifteen are peculiar to Porto Rico proper and six to Mona.
>
> On the other hand, Porto Rico has only 2 species in common with the Caribbean Islands, the same 2 species also ranging over the other larger Antilles. Two more species Porto Rico proper shares with the latter. The rest of the species occur in the Virgin Islands. Porto Rico thus forms with the latter a group characterized by an extraordinarily great proportion of peculiar species.
>
> But while the fauna of Porto Rico, both in itself and in combination with the Virgin Islands, shows a high amount of specialization demonstrating a considerable degree of isolation in time, it must not be imagined that the separation is very deep seated. On the contrary, the affinities with the other Antilles, especially the larger ones to the west, are very close and can readily be traced.
>
> Leaving, then, out of consideration the two species whose introduction we ascribe to man, *Hemidactylus mabouia* and *Leptodactylus albilabris*, the herpetological fauna of Porto Rico falls into two groups, namely, the species which have in all probability originally extended their range from northeastern South America and those whose ancestors came from the west, primarily from the present mainland of Central America, and secondarily from the other Great Antilles.
>
> Comparatively few, probably not more than five of the genera inhabiting Porto Rico, point toward South America.

Eigenmann, discussing the fresh-water fishes of western Cuba, writes (1902, p. 221):

> The origin of the Cuban fauna is then not far to seek. We have, as mentioned above, a number of marine species, more or less regular visitors of the fresh water. We have species widely distributed in the brackish water and coastwise streams whose presence is predicable (*Gobiidae*), and we have local modifications of families with a wide distribution in the brackish and fresh waters of the tropics of America (*Poeciliidae*). We have, furthermore, local adaptations of marine species to fresh water (*Brotulidae* and *Atherina*). The origin of all the above is simple of explanation. The species whose presence is of greatest interest are the strictly fresh-water species of *Lepisosteus*, evidently belonging to the North American fauna, and *Symbranchus* and *Heros* as evidently members of the South American fauna. The presence of the eel in the fresh waters of Cuba is to be expected, inasmuch as it very probably breeds in the ocean near Cuba. The presence of *Symbranchus*, *Heros*, and *Lepisosteus tristoechus* and *Agonostoma monticola* shows that the fresh-water

fauna of Cuba has a greater affinity for that of Mexico than for that of Florida, and that these forms probably reached Cuba by way of Yucatan.

The relict nature of so much of the Antillean fauna is demonstrated to be true for the spiders as well, by Lutz (1915, p. 141):

> To summarize what seems to be the facts concerning West Indian spiders: there has been considerable movement between the individual islands and also between the mainland and the islands, especially at the two ends of the island chain, even in recent times when the islands were separate from each other and from the mainland. It is therefore unnecessary to suppose that such connections ever existed. Ancient forms have had a longer time to reach the islands than the more recent ones, they were adapted to a tropical environment, and the insular character of the area has protected them, hence a large part of the fauna consists of relicts as is shown by the relationships with South Africa, Madagascar, Ceylon, Australia and the Philippines. Recent forms are now mingling with and replacing the older forms.

Simpson (1894, p. 427) believed that the distribution of the land mollusks favors a land connection between Antillea and the mainland, probably Florida. Whether one believes in such a connection or not, the nature of the land mollusk fauna is well summed up by Simpson:

> It has been claimed that there has never been land connection between the islands of this archipelago, and that the homogeneousness of its land and fresh-water molluscan fauna could be accounted for by supposing that many of the species had been carried from island to island, by storms or currents, or that they had been transported by other means. While no doubt a small proportion of the forms have thus migrated, yet the number of species common to two or more islands is so small, and the distribution of many of the genera and subordinate groups is so peculiar, that I believe we are not justified in explaining the present distribution by such an hypothesis. Cuba, with nearly 700 species of land and fresh-water mollusks, has only 53 not confined to the island; Jamaica, with over 500 species, has 41; Haiti, with 270 species, has only 30; and Puerto Rico, with 130 species, has 34 stragglers to other localities.
>
> Now, it is very remarkable that while many species of non-operculate land snails are common to the Greater Antilles and the continent, as well as to several of the different Lesser Antillean islands, not a single operculate is known to inhabit both the greater archipelago and the mainland of tropical America. Two species, *Chondropoma dentatum* and *Helicina subglobulosa*, and possibly a third, *Ctenopoma rugulosum*, all Cuban forms, are colonized in the extreme southern end of Florida, and although nearly half the species of land snails of these four larger islands are operculates, not more than 9 or 10 of them are found outside of a single island. This might be taken as evidence that the non-operculate forms were of much more ancient origin than the others, many of them reaching back to a time of former land connection, while the operculate species were of more recent development, which I suspect may be the case; or that the former are better adapted to migration across the ocean than the latter.

The fact that the operculates form so large a proportion of the Antillean land snail fauna, that a majority of the genera are found on two or more of the islands and the mainland, while nearly every species is absolutely restricted to a single island, appears to me to be very strong testimony in favor of a former general land connection.

I believe that all the evidence of the terrestrial and fluviatile molluscan fauna of this region indicates that in the early Tertiary Period, perhaps, there was a general land elevation of the Greater Antilles, and possibly of some of the adjacent area; that Wallace's theory of a land connection of the greater islands is correct; that during some part of this time a landway extended across to the continent; that the species and groups of this then connected territory migrated to some extent from one part of it to another, and that a probable connection existed over the Bahama plateau to what was at that time no doubt the island of Florida. It would appear that at this time the volcanic islands of the Lesser Antillean chain were not yet raised above the sea, or that if there was land in that region it has since been submerged, and there seems to be no good evidence in favor of any land connection with the Greater Antilles since the lifetime of the present groups and species of West Indian land and fresh-water mollusks.

The distribution of the decapods of the West Indies has considerable bearing on the origin of these islands, and the following quotations are the conclusions of Ortmann (1902, p. 295):

> Looking over the various connections between the different isolated areas of distribution of the different groups of crayfishes, which have been suggested by the above chorological and systematical discussions, we may itemize them in the following way: . . .
>
> 2. A connection of Cuba with Central America (Mexico).

Again, on page 309:

> The West Indian islands must have been once connected with Central and South America. The fresh-water crabs of the Greater Antilles point to a connection with Mexico, as well as to a connection between themselves, after they were separated from the mainland (*Epilobocera*). The fresh-water crabs of the Lesser Antilles point to a connection with Trinidad and Venezuela.

On page 347:

> According to the foregoing, the history of the development of the Central American and West Indian region, as supported by the fresh-water Decapods, is the following:
>
> Central America, the West Indies and the northern margin of South America formed in the Mesozoic period (certainly during Jurassic and Cretaceous) a continental mass (Antillean continent), which was bounded by sea to the north and south. This continent broke up at the end of the Cretaceous, the chief factor in its destruction being the formation of the Caribbean Sea. The northern remnant of this continent, consisting of the Greater Antilles and parts of present Central America, probably remained a unit up to the Eocene.

But at the end of the Eocene and during the Oligocene and Miocene the connection between the Greater Antilles and the mainland was severed. But it was reëstablished toward the end of the Tertiary (Pleistocene) and again destroyed in the recent time.

The flora of Porto Rico is like the fauna, characterized by the large number of endemic forms. Britton remarks in his introduction to the Botany of Porto Rico and the Virgin Islands (1923, p. 4):

> A large number of kinds of plants exist naturally only in Porto Rico and the Virgin Islands; these are termed endemic species. They are scattered in distribution, not being restricted to wet, dry, high, or low districts or to specific types of soil, though many of them appear, from our present knowledge, to be very local in distribution. All the endemic species are more or less closely related to other species inhabiting other West Indian Islands, indicating community of origin and differentiation through isolation. The cutting of the forests over the greater part of both Porto Rico and the Virgin Islands has probably eliminated some endemic species.

The number of citations which might be included are so great that it is beyond the province of this paper to attempt inclusion of even a small part of them. The authors selected will serve to show that there is a correlation and agreement in the various branches as to the peculiar nature of the West Indian fauna and flora. The broad facts of this distribution are beyond dispute; the interpretation of these facts and the creation of hypotheses provide ground for argument. Many writers could be quoted here whose views are opposed to those cited. These writers appear in the bibliography at the close of this paper and should be consulted for the other side of the picture. In most cases I have believed that the weight of authority was in favor of the views quoted, and limitations of space permit me to touch upon the high lights only. For a very full and thorough summing up of all the factors bearing on the history of the West Indies, the reader is referred to Scharff (1911, pp. 261–294, and 1922, pp. 65–72).

I have not discussed the possible eastward extension of the hypothetical Antillea or the possible existence of the mythical Atlantis. It is admitted that some of the features of the fauna of the Antilles could be very handily accounted for by a land connection to Africa. The evidence in favor of such a connection is, I think, far outweighed by the evidence against it, and I should be quite satisfied with the one continental contact, namely, with Central America. The facts, deduced from whatever source, strongly support the following conclusions:

1. That the faunas of the Antilles contain an unusually high percentage of relict forms and endemic types.

2. That there are rather distinct lines separating the faunas of the Greater Antilles from those of the Lesser Antilles.

3. That the waif elements in the faunas can usually be readily recognized, and that they are sharply marked off from the truly Antillean section of the fauna.

4. That the nature and distribution of the faunas favor an Antillean land-mass or subcontinent which included certainly, Cuba, Haiti, Porto Rico and the Virgins, probably Jamaica, and possibly Anguilla and St. Martins.

5. That the nature and distribution of the faunas of the Great Antilles are best explained by the assumption of a hypothetical contact with Central America at either one or two points, Yucatan or Honduras, during Tertiary time.

6. That the faunas of the Greater Antilles are not so well accounted for by a hypothetical contact through the Lesser Antilles, and that the evidence is against such a connection to South America, and also against a connection to North America through the Bahamas and Florida.

The origin of the mammalia of Porto Rico may be summarized under the following heads:

1. The mammals are predominately South American in affinities, but well differentiated through long separation.

2. The percentage of relict forms and endemic types is high.

3. No one locality on the continents as known today could supply Porto Rico with all its mammals or, apparently, with forms descended from common ancestors.

4. The correlation between the mammalia of Porto Rico and that of Cuba and Haiti indicates beyond doubt a common origin (of some antiquity, however) ; and a similar, but more remote, relationship with the mammalia of Jamaica is implied.

5. The theory of fortuitous distribution of life-raft transportation will not adequately account for the mammals of Porto Rico, granting that only Chiroptera, Insectivora, Edentata and Rodentia are known from the island.

6. A connection or connections with Central America during Tertiary time would allow Porto Rico to receive migrants from South America and from North America as well, and such an hypothesis explains most satisfactorily the facies of the Porto Rican mammalia. It does not explain, however, the absence of continental types we may logically expect.

The absence of expected mainland types on Porto Rico, while not capable of very satisfactory explanation by the land-connection theory, is outweighed by the presence of the known mammalia of Porto Rico.

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[18] The following list of papers was consulted in the preparation of this report. It will be noted from the titles that many of the publications have little or no direct bearing upon the mammals of Porto Rico. However, the discussion of the origin of the Antilles entails considerable search in the literature on subjects other than mammals, and accordingly a few titles have been selected from the host of papers which have been written upon the West Indies and the island life.

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Figs. 6a, 6b, 6c, 6d, 7. Left humerus.
Plate XX. *Elasmodontomys obliquus.*
Figs. 8a, 8b, 8c, 8d. Right ulna.
Figs. 9a, 9b. Right radius.
Plate XXI. *Elasmodontomys obliquus.*
Figs. 1a, 1b, 1c, 1d. Left femur.
Fig. 2. Left tibia.
Plate XXII. *Elasmodontomys obliquus.*
Figs. 3a, 3b, 3c, 3d. Left tibia.
Figs. 4a, 4b. Right fibula.
Plate XXIII. *Elasmodontomys obliquus.*
Figs. 1a, 1b. Left innominate.
Plate XXIV. *Elasmodontomys obliquus.*
Fig. 1c. Left innominate.
Figs. 2a, 2b. Sacrum.
Plate XXV. *Elasmodontomys obliquus.*
Fig. 3. Atlas.
Figs. 4a, 4b. Axis.
Figs. 5, 6, 7, 8. Thoracic vertebræ.
Figs. 9a, 9b. Caudal vertebra.
Fig. 10. Rib.
Plate XXVI. *Elasmodontomys obliquus.*
Fig. 5. Rib.
Figs. 6a, 6b. Series of five cervical vertebræ.
Figs. 7a, 7b. Lumbar vertebræ.
Plate XXVII. *Isolobodon portoricensis.*
Figs. 1a, 1b, 1c, 2. Skull.
Plate XXVIII. *Isolobodon portoricensis.*
Figs. 3, 4. Skull.
Figs. 5a, 5b, 5c, 6a, 6b. Mandible.
Plate XXIX. *Plagiodontia ædium.*
Figs. 7a, 7b, 7d. Skull.
Figs. 8a, 8b, 8c. Mandible.
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Figs. 2a, 2b. Acromion process, *Elasmodontomys.*
Figs. 3a, 3b. Left clavicle. *Elasmodontomys.*
Fig. 4. Ribs. *Isolobodon.*
Figs. 5a, 5b, 5c. Right ulna, *Isolobodon.*
Plate XXXI. *Isolobodon portoricensis.*
Figs. 6a, 6b, 6c. Left ulna.
Figs. 7a, 7b, 7c. Right humerus.
Figs. 8a, 8b, 8c. Left radius.
9a, 9b, 9c, 9d. Right femur.

Plate XXXII. *Isolobodon portoricensis.*
Figs. 10a, 10b, 10c, 10d. Left femur.
Figs. 11a, 11b. Left tibia.
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Plate XXXIII. *Isolobodon portoricensis.*
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Plate XXXIV. *Heteropsomys insulans.*
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Fig. 1e. Maxillary tooth-row.

Plate XXXV. *Heteropsomys insulans* and *Homopsomys antillensis.*
Fig. 1f. Mandible, *Heteropsomys.*
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Figs. 3a, 3b. Skull, *Homopsomys.*
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Fig. 3c. Skull, *Homopsomys.*
Fig. 5. Atlas, *Heteropsomys.*
Fig. 6. Lumbar vertebra, *Heteropsomys.*
Figs. 7a, 7b, 7c. Skull fragment, *Heptaxodon.*
Fig. 7d. Premolar, *Heptaxodon.*
Fig. 8. Left mandible, *Heptaxodon.*
Fig. 9. Crown view of lower premolar, *Heptaxodon.*

Plate XXXVII. *Acratocnus odontrigonus.*
Skull, No. 17720, lateral aspect.
Right jugal.

Plate XXXVIII. *Acratocnus odontrigonus.*
Mandible, two views.

Plate XXXIX. *Acratocnus odontrigonus.*
Skulls, No. 17720 and No. 17721, dorsal aspect.

Plate XL. *Acratocnus odontrigonus.*
Skulls, No. 17722 and No. 17715, dorsal aspect.

Plate XLI. *Acratocnus odontrigonus.*
Right scapula, two views.

Plate XLII. *Acratocnus odontrigonus.*
Skulls, No. 17715 and No. 17720, ventral aspect.

Plate XLIII. *Acratocnus odontrigonus.*
Skull, No. 17715, lateral aspect.

Plate XLIV. *Acratocnus major.*
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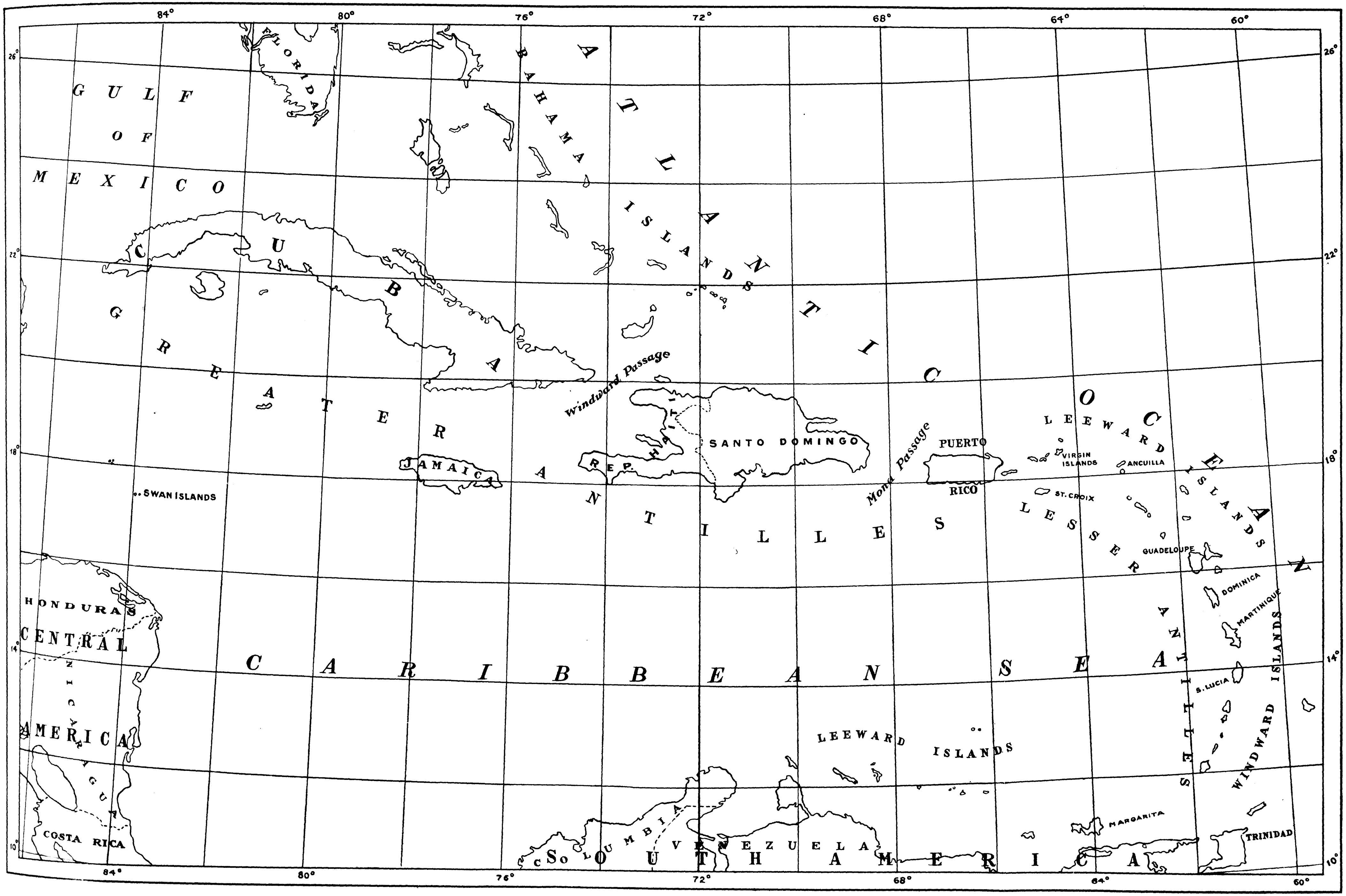
Fig. 2a. Fragment of skull.

Plate XLV. *Acratocnus major.*
Fig. 2b. Basicranial region.
Fig. 2c. Orbital section.

Plate XLVI. *Acratocnus odontrigonus* and *Acratocnus major.*
Figs. 6a, 6b. Fragment of sacrum, *odontrigonus.*
Fig. 7a. Left innominate, *major.*

Plate	XLVII.	*Acratocnus odontrigonus* and *Acratocnus major*.
		Figs. 1a, 1b. Right tibia, *odontrigonus*.
		Fig. 2. Right tibia, *major*.
		Fig. 3. Left tibia, *odontrigonus*.
Plate	XLVIII.	*Acratocnus odontrigonus*.
		Figs. 4a, 4b. Left fibula.
		Figs. 5a, 5b. Left radius.
Plate	XLIX.	*Acratocnus odontrigonus* and *Acratocnus major*.
		Figs. 1a, 1b, 1c. Right humerus, *odontrigonus*.
		Fig. 2a. Right humerus, *major*.
Plate	L.	*Acratocnus odontrigonus* and *Acratocnus major*.
		Fig. 2b. Left humerus, *major*.
		Fig. 3. Right humerus, *odontrigonus*.
		Figs. 4a, 4b. Left ulna, *odontrigonus*.
		Fig. 5. Left ulna, *major*.
Plate	LI.	*Acratocnus odontrigonus*.
		Figs. 1, 2. Right femur.
		Figs. 3a, 3b. Left femur.
Plate	LII.	*Acratocnus odontrigonus* and *Acratocnus major*.
		Fig. 3c. Left femur, *odontrigonus*.
		Fig. 4. Distal extremity of left femur, *major*.
		Figs. 5a, 5b. Left calcaneum, *odontrigonus*.
		Fig. 6. Right calcaneum, *major*.
		Figs. 7a, 7b. Left astragulus, *odontrigonus*.
Plate	LIII.	*Acratocnus odontrigonus*.
		Caudal series of vertebræ.
Plate	LIV.	*Acratocnus*.
		Fig. 2. Pubic region, *odontrigonus*.
		Fig. 3. Ungual phalanges, *Acratocnus*.
		Figs. 4a, 4b. Ungual phalanx, *odontrigonus*.



Map of the West Indian region to show Porto Rico in its geographical relation to other islands

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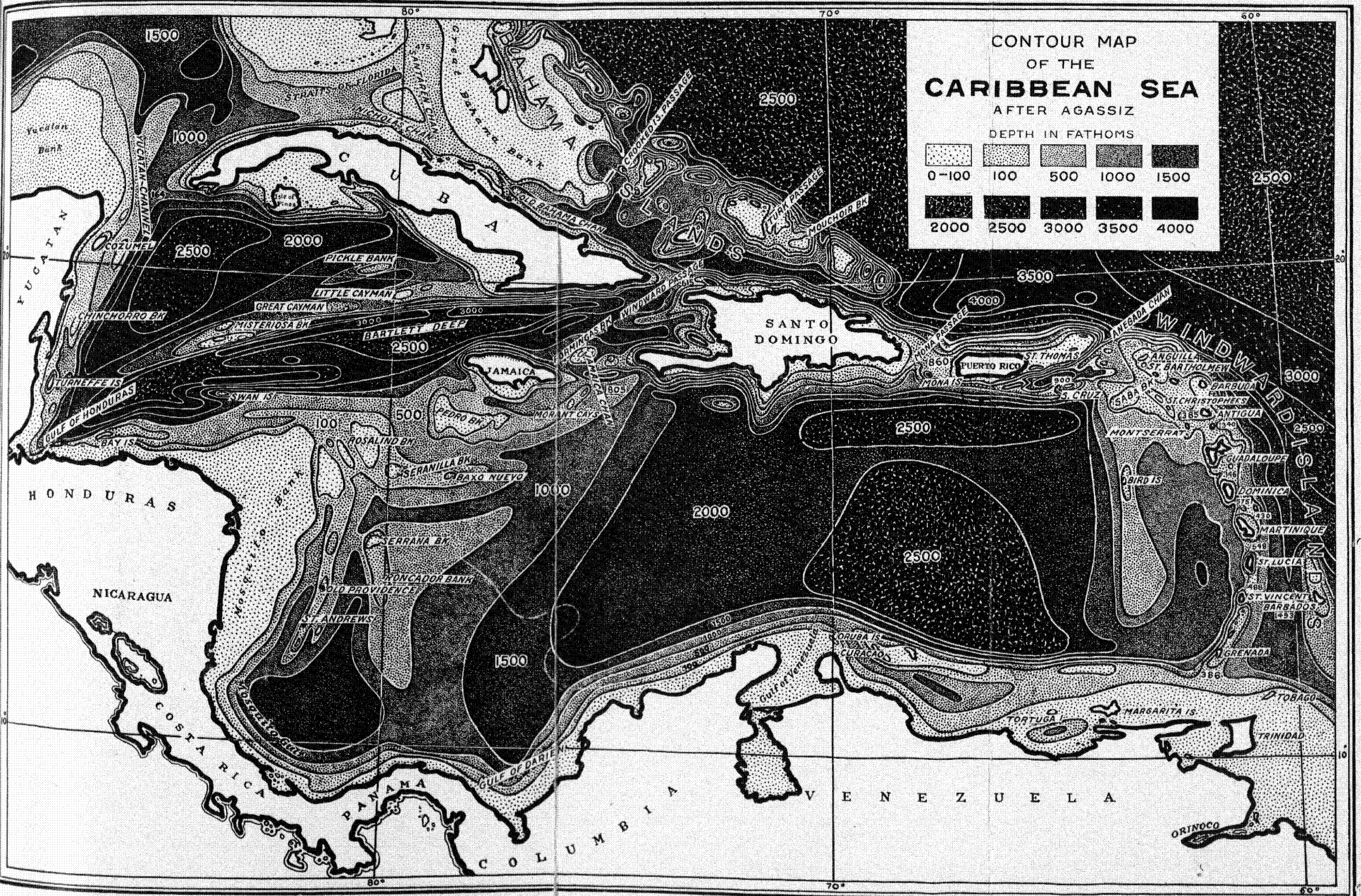
CONTOUR MAP
OF THE
CARIBBEAN SEA
AFTER AGASSIZ
DEPTH IN FATHOMS
0–100
100
500
1000
1500
2000
2500
3000
3500
4000
80°
70°
60°
20
10
1500
1000
2500
2000
3000
3500
4000
500
100
Yucatan Bank
YUCATAN
YUCATAN CHANNEL
COZUMEL
CHINCHORRO BK
TURNEFFE IS
GULF OF HONDURAS
BAY IS
STRAITS OF FLORIDA
SANTAREN CHAN
NICHOLAS CHAN
Great Bahama Bank
BAHAMA ISLANDS
CROOKED IS. PASSAGE
TURK PASSAGE
MOUCHOIR BK
CUBA
Isle of Pines
OLD BAHAMA CHAN
PICKLE BANK
LITTLE CAYMAN
GREAT CAYMAN
MISTERIOSA BK
BARTLETT DEEP
SWAN IS
WINDWARD PASSAGE
FORMINGAS BK
JAMAICA
PEDRO BK
MORANT CAYS
ROSALIND BK
SERANILLA BK
BAXO NUEVO
SERRANA BK
RONCADOR BANK
OLD PROVIDENCE
ST. ANDREWS
Mosquito Bank
SANTO DOMINGO
MONA PASSAGE
MONA IS
860
PUERTO RICO
ST. THOMAS
S. CRUZ
ANEGADA CHAN
ANGUILLA
ST. BARTHOLMEW
SABA BK
BARBUDA
ST. CHRISTOPHERS
ANTIGUA
MONTSERRAT
GUADALOUPE
BIRD IS
DOMINICA
MARTINIQUE
ST. LUCIA
ST. VINCENT
BARBADOS
GRENADA
TOBAGO
TRINIDAD
WINDWARD ISLANDS
ORUBA IS
CURACAO
Gulf of Venezuela
TORTUGA I
MARGARITA IS
ORINOCO
HONDURAS
NICARAGUA
COSTA RICA
PANAMA
GULF OF DARIEN
Mosquito Gulf
COLUMBIA
VENEZUELA

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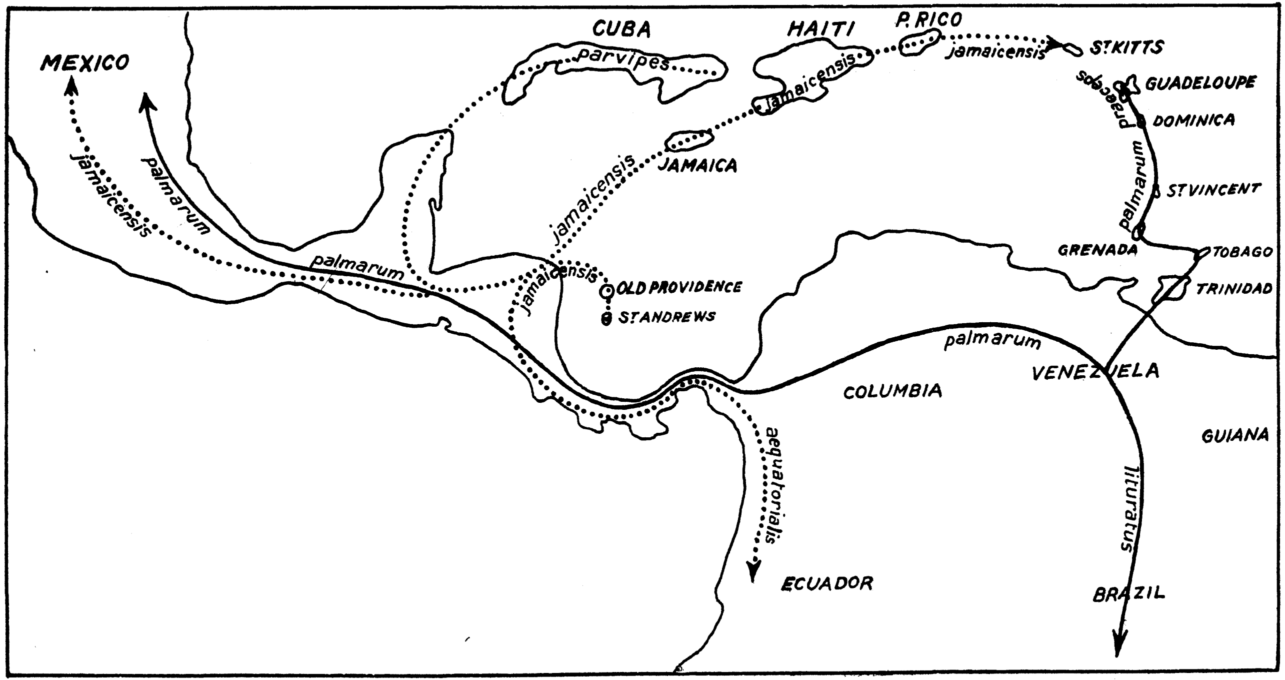
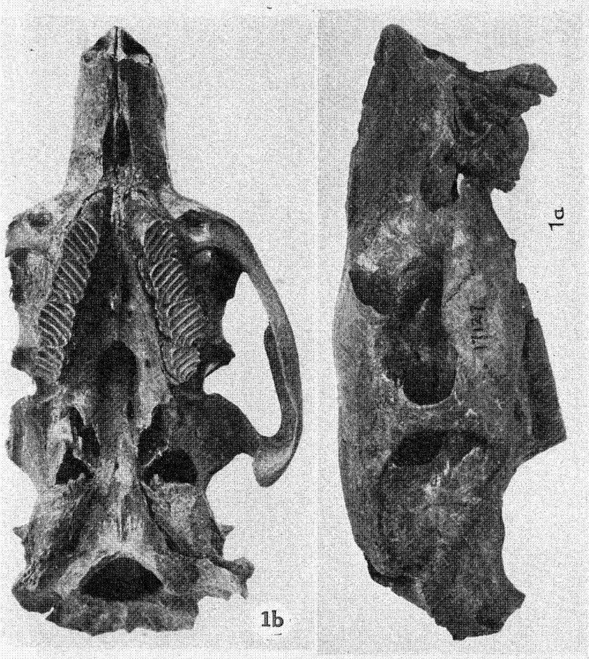
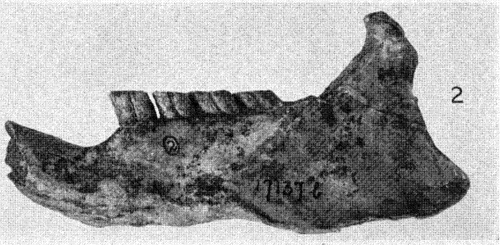


Map showing distribution of the species of the genus *Artibeus* in the Antilles, Central America and northern South America, after Anderson, P. Z. S., 1908. This group of bats has apparently arrived in the Antilles over two distinct migration routes, *jamaicensis* and its subspecies *parvipes* from Central America, *palmarum præceps* from South America.





ELASMODONTOMYS OBLIQUUS

Figures natural size

Figs. 1a, 1b. Skull, No. 17127, Morovis, Porto Rico.
Fig. 2. Left mandible, No. 17137b, Utuado, Porto Rico.

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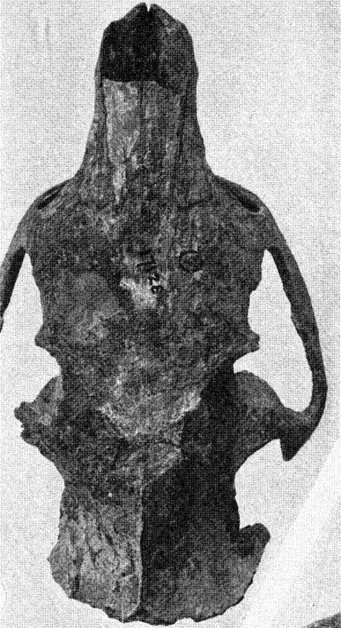
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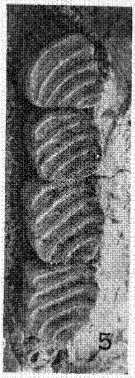
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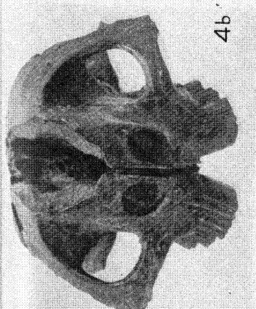
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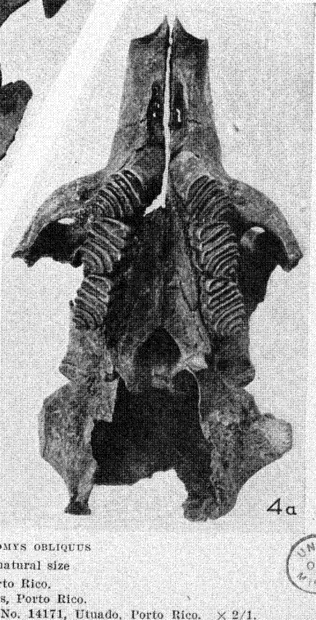
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Elasmodontomys obliquus

Figures natural size

Fig. 3. Skull, No. 17126, Morovis, Porto Rico.
Figs. 4a, 4b. Skull, No. 17132, Morovis, Porto Rico.
Fig. 5. Maxillary tooth-row of skull, No. 14171, Utuado, Porto Rico. × 2/1.

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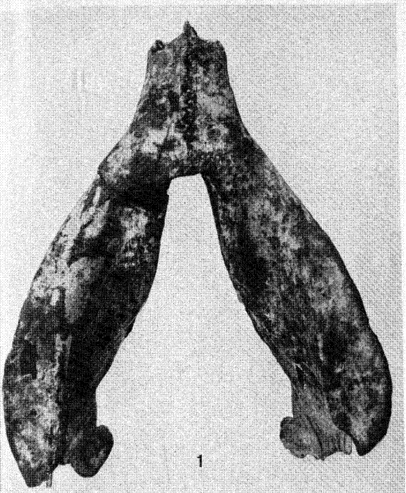

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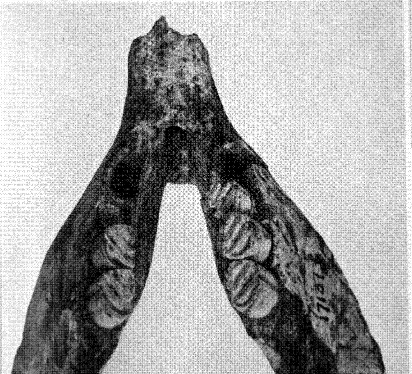

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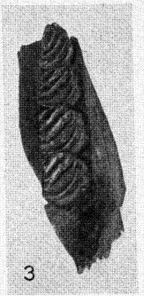

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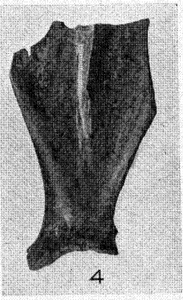

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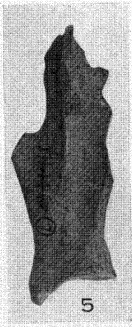

5

Elasmodontomys obliquus

Figures natural size

Figs. 1, 2. Mandible, No. 17137a, Utuado, Porto Rico.
Fig. 3. Mandibular tooth-row, No. 17137k, Morovis, Porto Rico.
Fig. 4. Scapula, No. 17144c, Morovis, Porto Rico.
Fig. 5. Scapula, No. 17144b, Morovis, Porto Rico.

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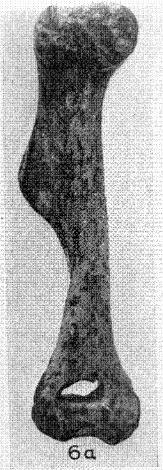
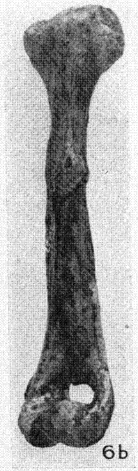
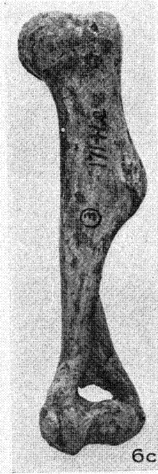
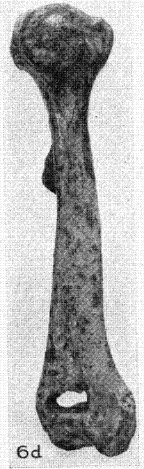
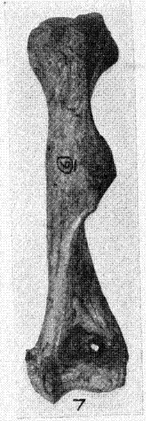






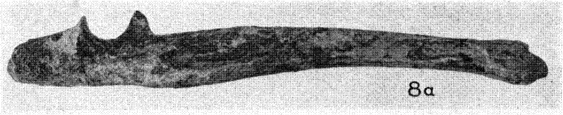




ELASMODONTOMYS OBLIQUUS

Figures natural size

Figs. 6a, 6b, 6c, 6d. Left humerus, No. 17143e, Utuado, Porto Rico.
Fig. 7. Left humerus, No. 17141i, Morovis, Porto Rico.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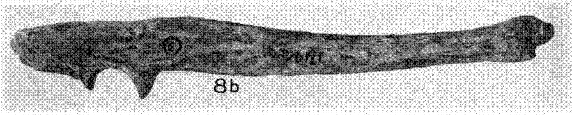
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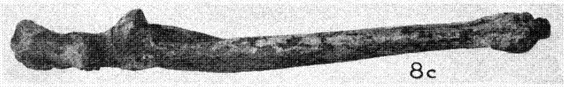
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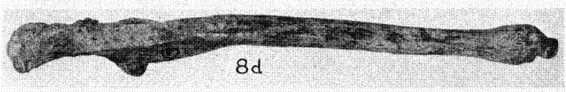
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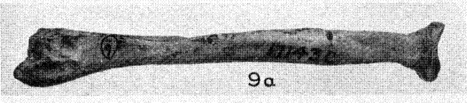
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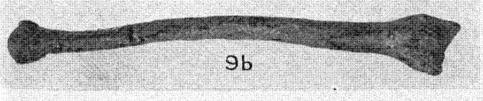
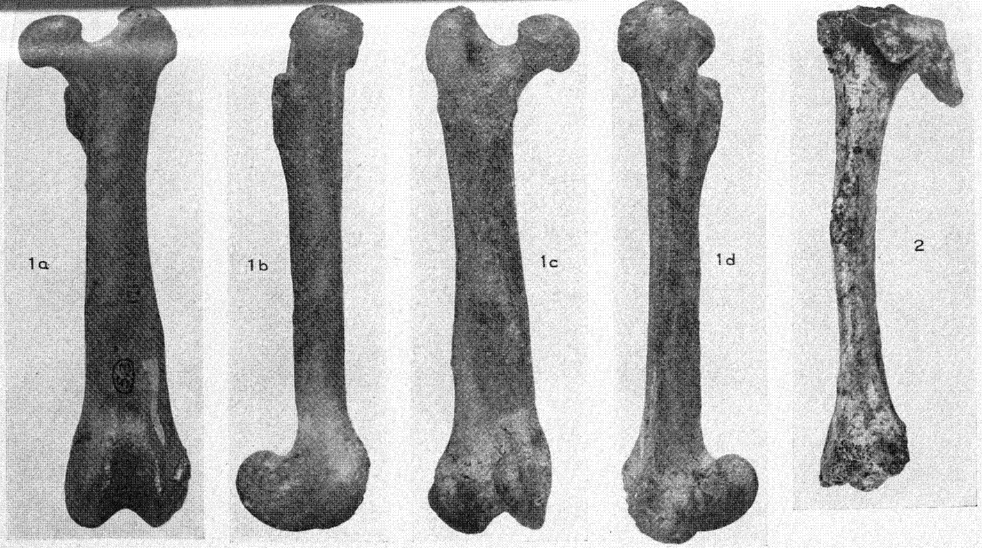

9b

ELASMODONTOMYS OBLIQUUS

Figures natural size

Figs. 8a, 8b, 8c, 8d. Right ulna, No. 17142a, Utuado, Porto Rico.
Figs. 9a, 9b. Right radius, No. 17143c, Morovis, Porto Rico.



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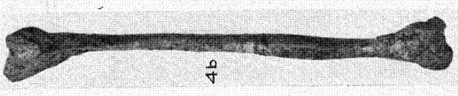
ELASMODONTOMYS OBLIQUUS, FROM UTUADO, PORTO RICO
Figures natural size
Figs. 1a, 1b, 1c, 1d. Left femur, No. 17138k.
Fig. 2. Left tibia, No. 17139d.



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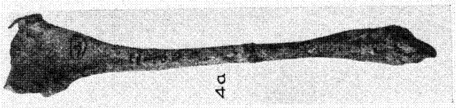

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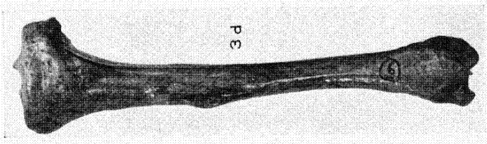

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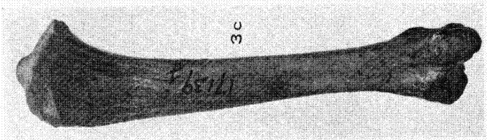

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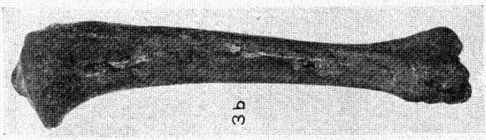

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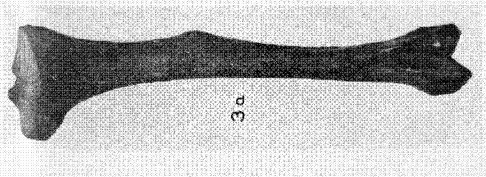

3a

ELASMODONTOMYS OBLIQUUS, FROM MOROVIS, PORTO RICO

Figures natural size

Figs. 3a, 3b, 3c, 3d. Left tibia, No. 17139J.
Figs. 4a, 4b. Right fibula, No. 17140a.

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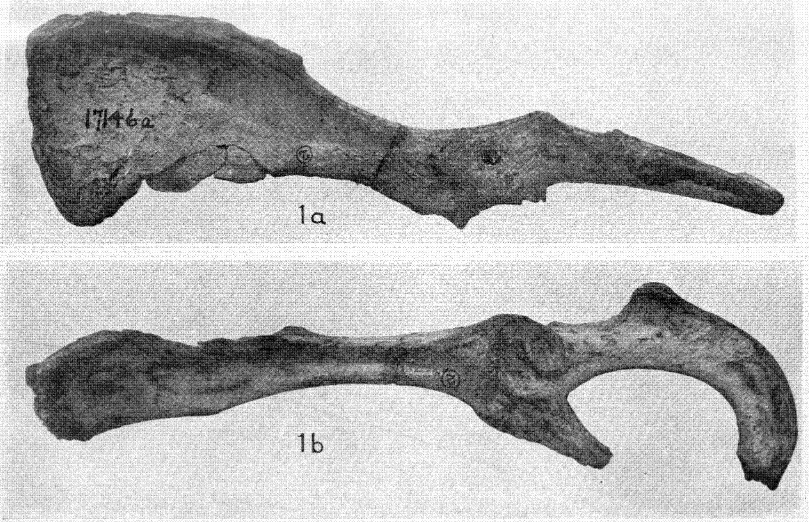

ELASMODONTOMYS OBLIQUUS, FROM UTUADO, PORTO RICO

Figures natural size

Figs. 1a. Left innominate, No. 17146a, dorsal aspect.
Fig. 1b. Same bone, lateral aspect.

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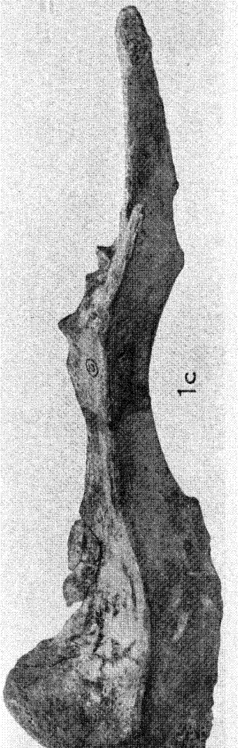
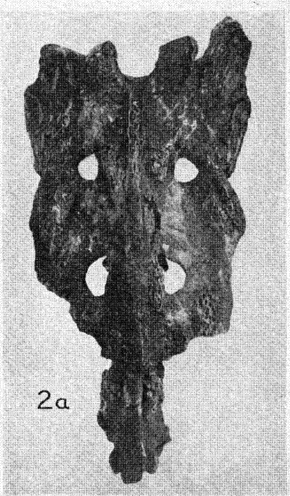




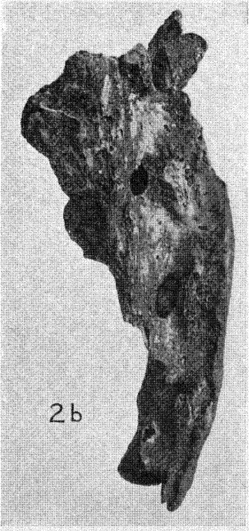
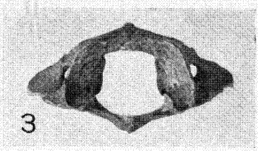
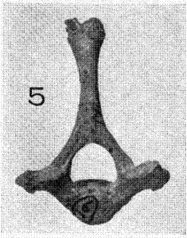
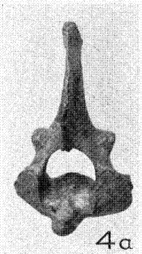


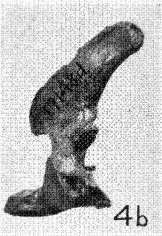
Fig. 1c. Left innominate, No. 17146a, ventral aspect.
Fig. 2a. Sacrum, No. 17147a, dorsal aspect.
Fig. 2b. Same bone, lateral aspect.
Figures natural size

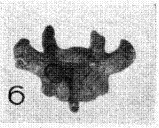
Elasmodontomys obliquus, from Utuado, Porto Rico

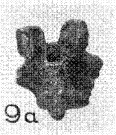


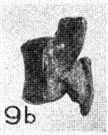


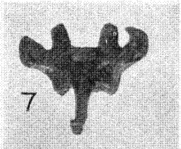


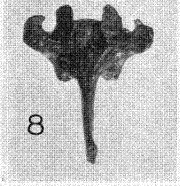


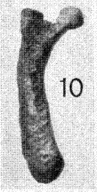








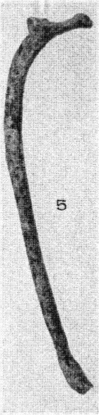




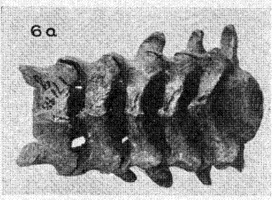
ELASMODONTOMYS OBLIQUUS

Figures natural size

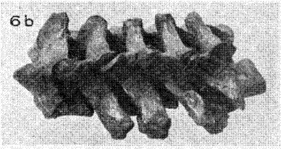
Fig. 3. Atlas, No. 17148c, Morovis, Porto Rico, anterior aspect.
Figs. 4a, 4b. Axis, No. 17148d, Morovis, Porto Rico, anterior and lateral aspects.
Figs. 5, 6, 7, 8. Thoracic vertebræ, Porto Rico.
Figs. 9a, 9b. Caudal vertebra, dorsal and lateral aspects, Porto Rico.
Fig. 10. Rib, Porto Rico.



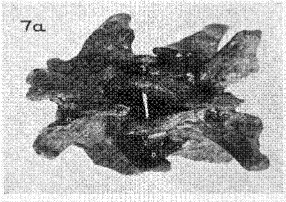
5



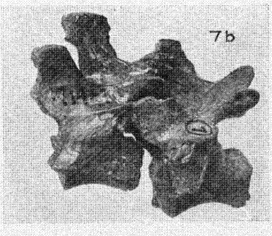
6a



6b



7a

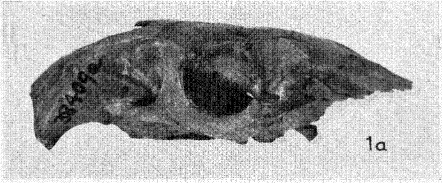


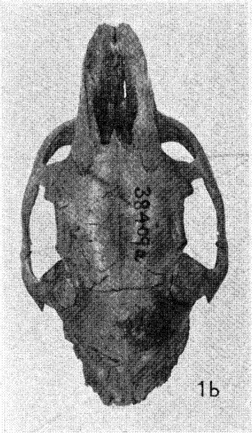
7b

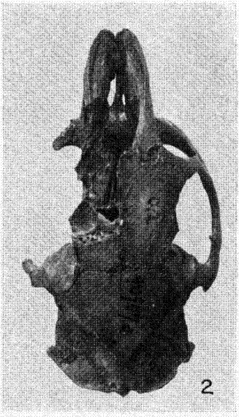
ELASMODONTOMYS OBLIQUUS

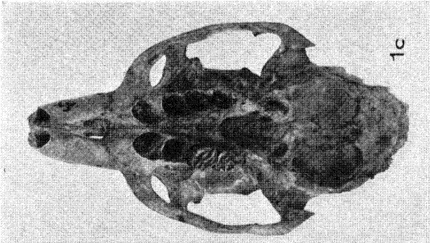
Figures natural size

Fig. 5. Rib, Porto Rico.
Figs. 6a, 6b. Series of five cervical vertebræ, No. 17148g, Morovis, Porto Rico.
Figs. 7a, 7b. Lumbar vertebræ, No. 17148t, Morovis, Porto Rico.









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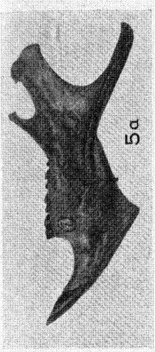
SKULLS OF ISOLOBODON PORTORICENSIS, FROM UTUADO, PORTO RICO
Figures natural size
Figs. 1a, 1b, 1c. No. 38409a, type specimen.
Fig. 2. No. 40957a.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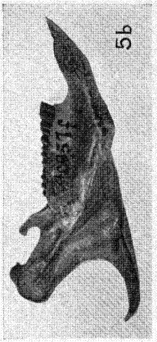
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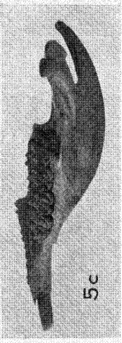
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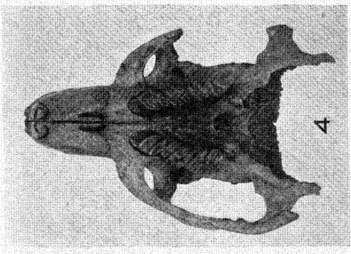
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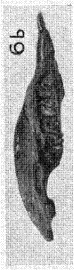
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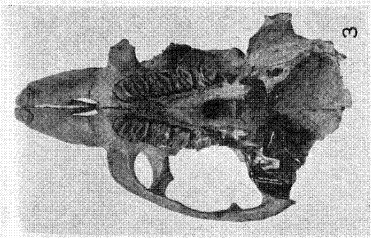
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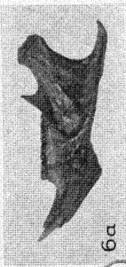
6a

SKULLS AND MANDIBLES OF ISOLOBODON PORTORICENSIS, FROM UTUADO, PORTO RICO.

Figures natural size

Fig. 3. No. 38409b. Figs. 5a, 5b, 5c. No. 40957f.
Fig. 4. No. 38409c. Figs. 6a, 6b. No. 40957p.

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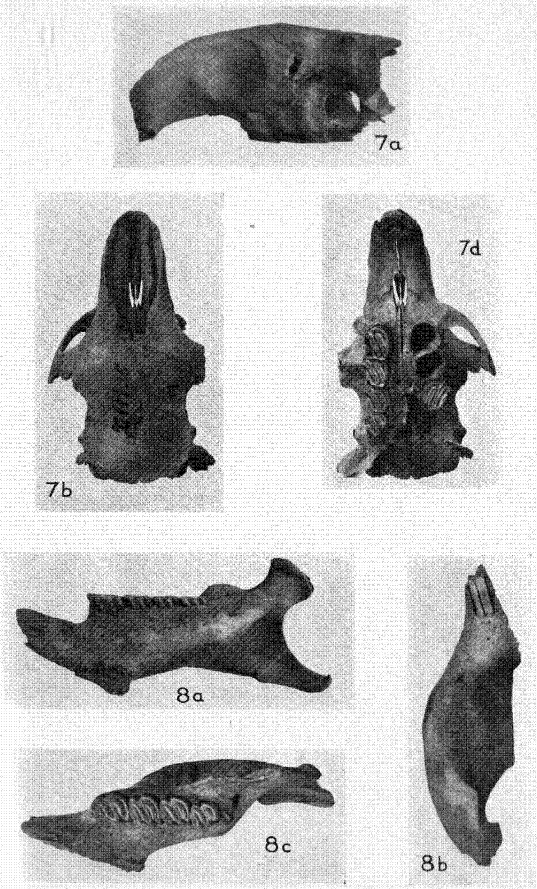
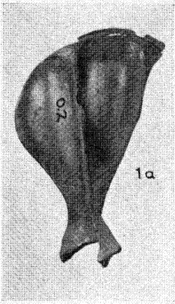


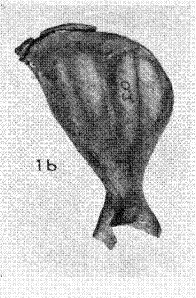
Skulls and mandibles of Plagiodontia ædium, from Santo Domingo, Porto Rico, for comparison with Isolobodon portoricensis

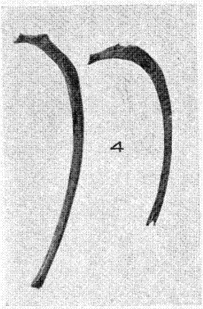
Figures natural size

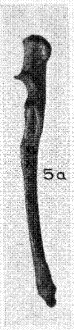
Figs. 7a, 7b, 7d. No. 217112, U. S. N. M.
Figs. 8a, 8b, 8c. No. 217126, U. S. N. M.

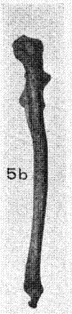
UNIV. OF MICH.

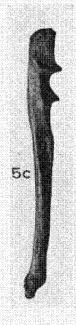


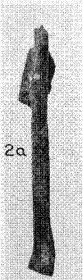


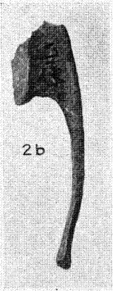


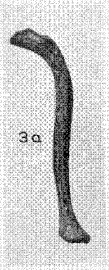


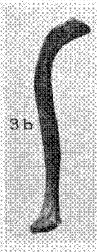












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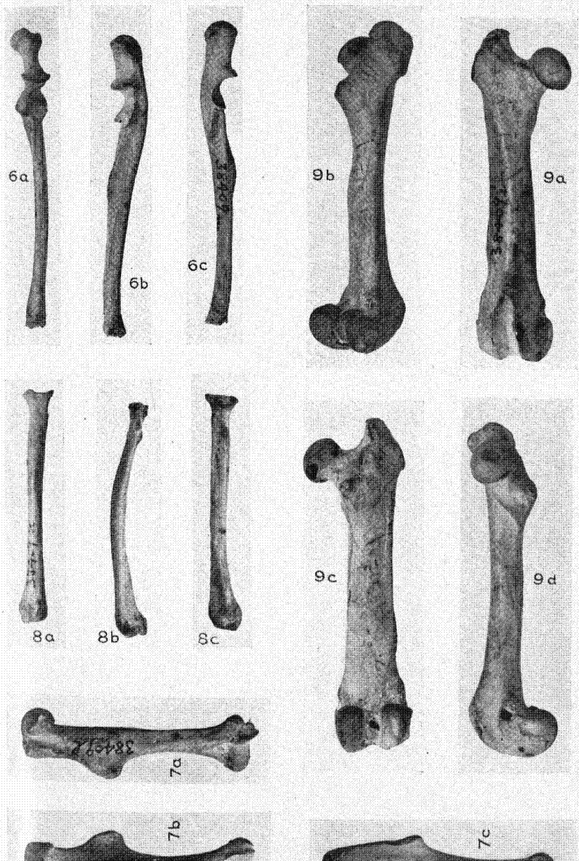
Figures natural size

Figs. 1a, 1b. Right scapula, *Isolobodon portoricensis*, No. 38409b. Utuado, Porto Rico.
Figs. 2a, 2b. Acromion process, *Elasmodontomys obliquus*, No. 17144i, Porto Rico.
Figs. 3a, 3b. Left clavicle, *Elasmodontomys obliquus*, No. 17145, Morovis, Porto Rico.
Fig. 4. Ribs of *Isolobodon portoricensis*, Porto Rico.
Figs. 5a, 5b, 5c. Right ulna, *Isolobodon portoricensis*, No. 40963, Utuado, Porto Rico.



ISOLOBODON PORTORICENSIS, FROM UTUADO, PORTO RICO

Figures natural size

Figs. 6a, 6b, 6c. Left ulna, No. 38409m.
Figs. 7a, 7b, 7c. Right humerus, No. 38409l.
Figs. 8a, 8b, 8c. Left radius, No. 38409n.
Figs. 9a, 9b, 9c, 9d. Right femur, No. 38409l.

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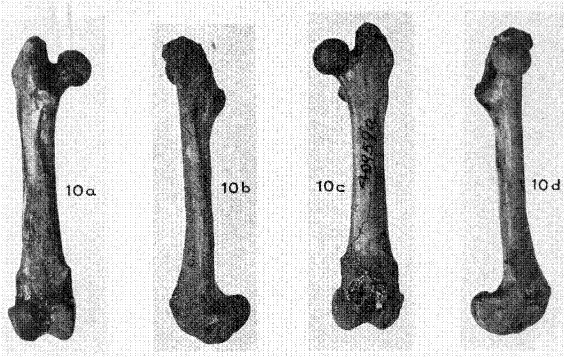

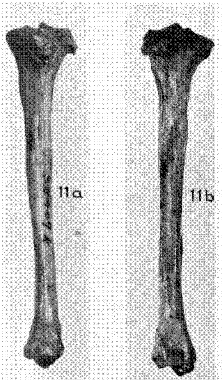

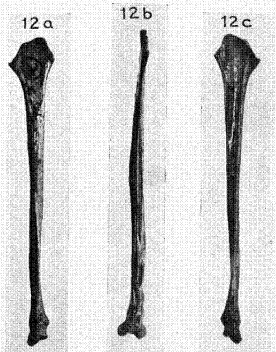

Isolobodon portoricensis, from Utuado, Porto Rico

Figures natural size

Figs. 10a, 10b, 10c, 10d. Left femur, No. 40959a, juvenile?
Figs. 11a, 11b. Left tibia, No. 38409k.
Figs. 12a, 12b, 12c. Left fibula, No. 40961d.

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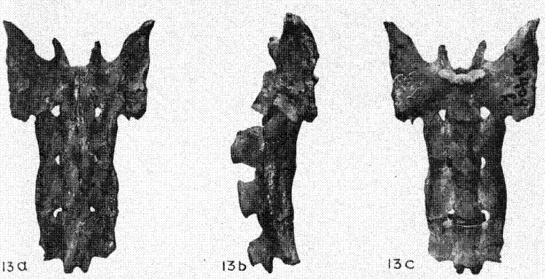

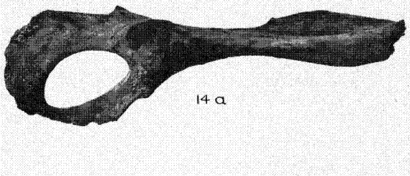

Isolobodon portoricensis, from Utuado, Porto Rico

Figures natural size

Figs. 13a, 13b, 13c. Sacrum, No. 48409h.

Figs. 14a, 14b, 14c. Right innominate, No. 38409j.

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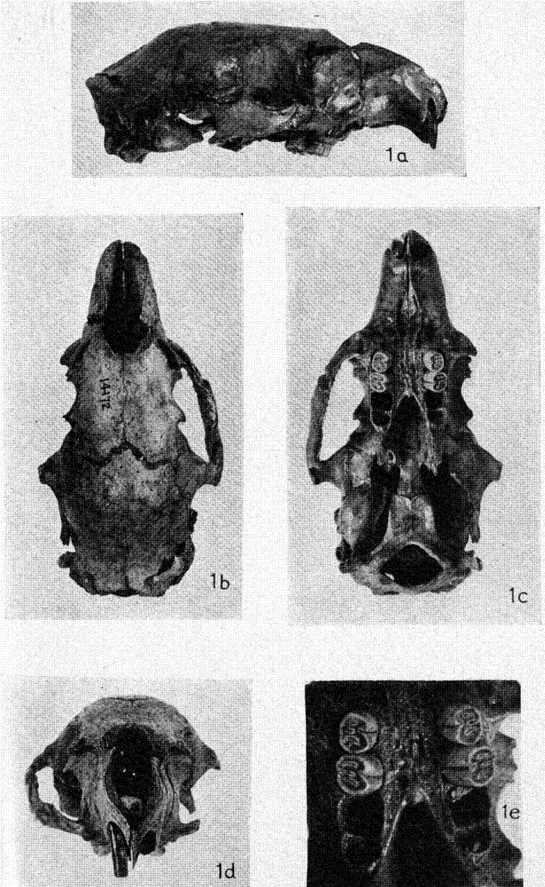
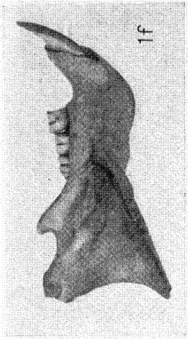
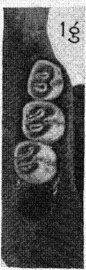
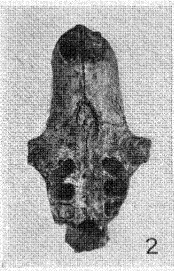


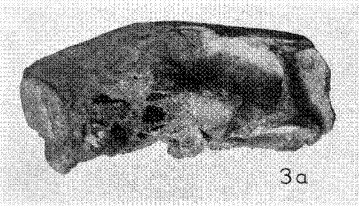
SKULL OF HETEROPSOMYS INSULANS, FROM UTUADO, PORTO RICO

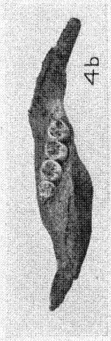
Figs. 1a, 1b, 1c, 1d. No. 14172. Type. × 1/1.
Fig. 1e. Same skull, maxillary tooth-row. × 2/1.

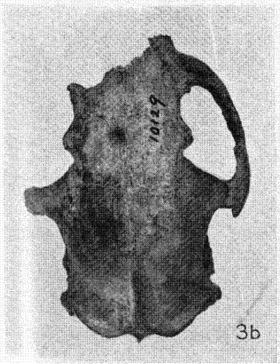












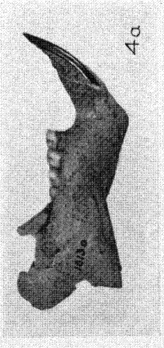


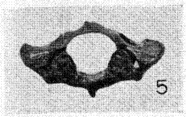
Fig. 1f. Mandible, *Heteropsomys insulans*, No. 14172, type, Utuado, Porto Rico. × 5/4.

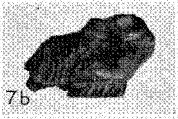
Fig. 1g. Mandibular molar series, *Heteropsomys insulans*, No. 14172, type, crown view. × 2/1.

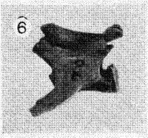
Fig. 2. Palate, *Homopsomys antillensis*, No. 17102, type, Utuado, Porto Rico. × 1/1.

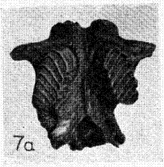
Figs. 3a, 3b. Skull, *Homopsomys antillensis*, No. 10129, Mus. Comp. Zoöl., Ciales, Porto Rico. × 1/1.

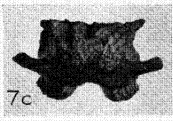
Figs. 4a, 4b. Mandible, *Homopsomys antillensis*, No. 10130, Mus. Comp. Zoöl., Ciales, Porto Rico. × 1/1.

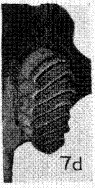


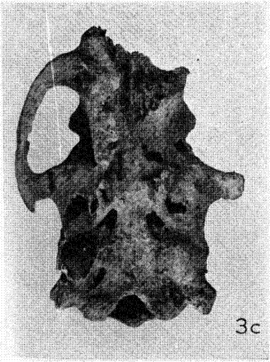


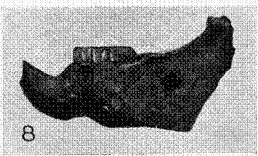


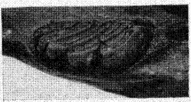












9

Fig. 3c. Skull, *Homopsomys antillensis*, No. 10129, Mus. Comp. Zoöl., Ciales, Porto Rico. × 1/1.

Fig. 5. Atlas, *Heteropsomys insulans*, No. 14172, Utuado, Porto Rico. × 1/1.

Fig. 6. Lumbar vertebra, *Heteropsomys insulans*, No. 14172, Utuado, Porto Rico. × 1/1.

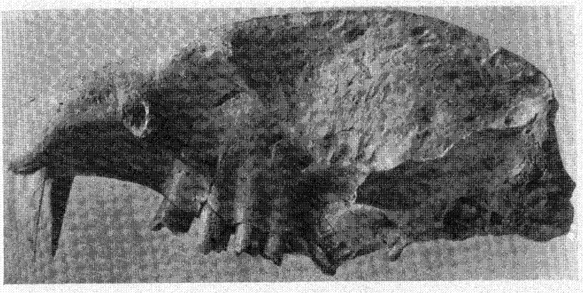
Figs. 7a, 7b, 7c. Skull fragment, *Heptaxodon bidens*, No. 17101, type, Utuado, Porto Rico. × 1/1.

Fig. 7d. Premolar, *Heptaxodon bidens*, No. 17101, Utuado, Porto Rico. × 2/1.

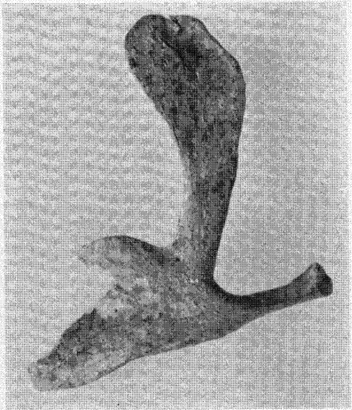
Fig. 8. Left mandible, *Heptaxodon bidens*, Morovis, Porto Rico. × 1/1.

Fig. 9. Crown view of lower premolar, *Heptaxodon bidens*, Morovis, Porto Rico. × 2/1.

ACRATOCNUS ODONTRIGONUS, FROM NEAR MOROVIS, PORTO RICO

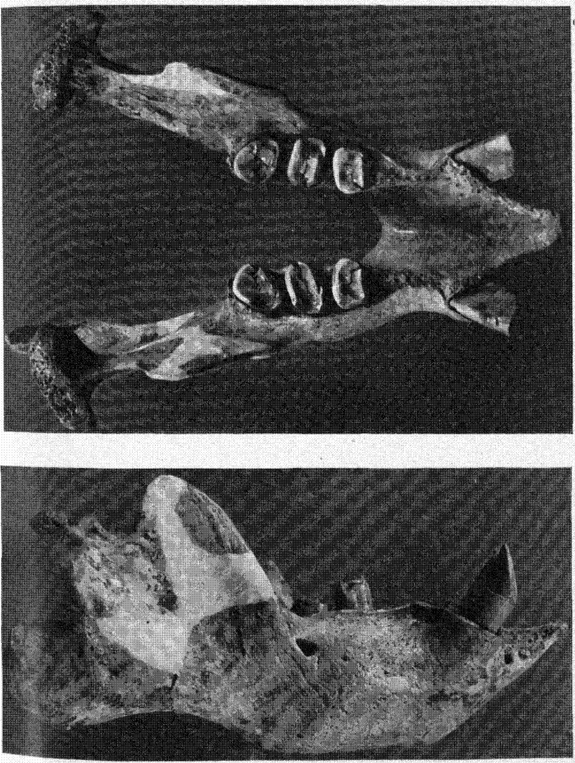


Skull, No. 17720, approximately seven-ninths natural size.



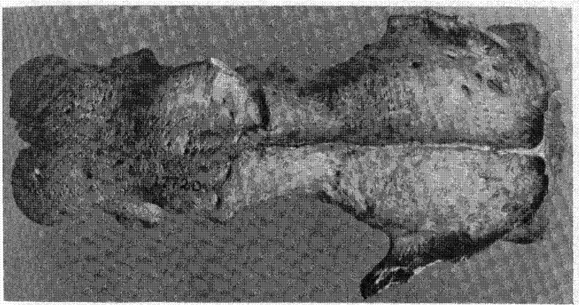
Right jugal, No. 17711, approximately natural size.

Acratocnus odontrigonus, from near Morovis, Porto Rico

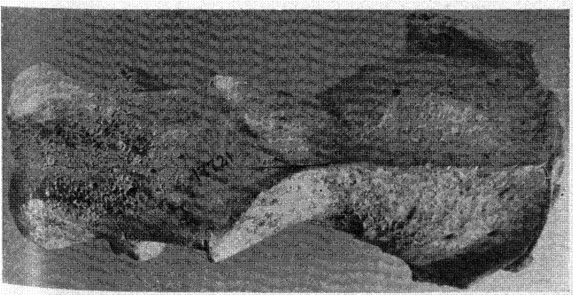


Two views of mandible, No. 17717, approximately natural size.

ACRATOCNUS ODONTRIGONUS, FROM NEAR MOROVIS, PORTO RICO

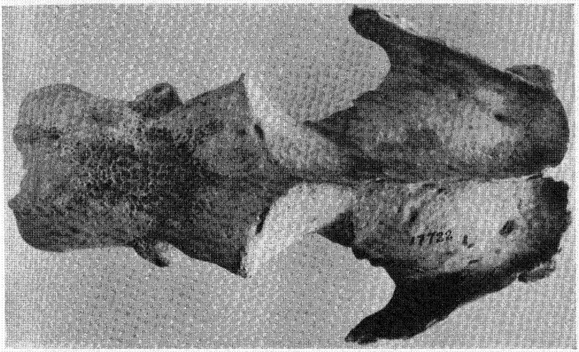


Skull, No. 17720, approximately seven-ninths natural size.

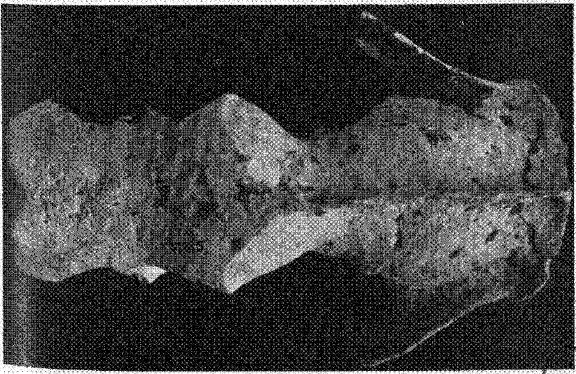


Skull, No. 17721, approximately seven-ninths natural size.

ACRATOCNUS ODONTRIGONUS, FROM NEAR MOROVIS, PORTO RICO

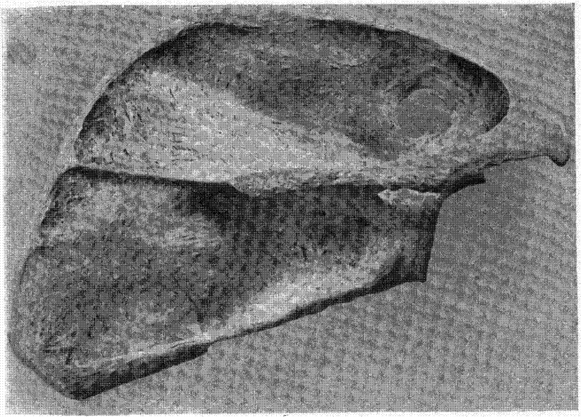


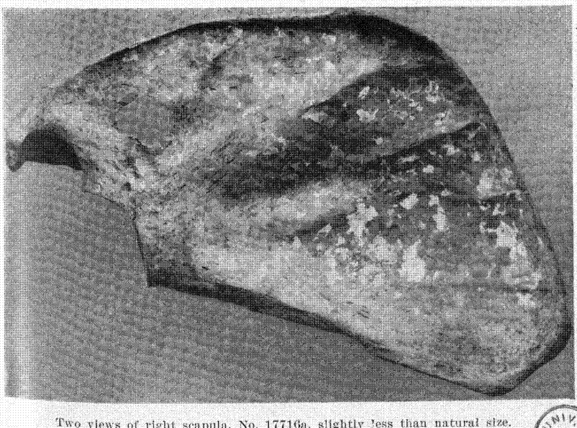
Skull, No. 17722, approximately nine-tenths natural size.



Skull, No. 17715, approximately four-fifths natural size.

ACRATOCNUS ODONTRIGONUS, FROM NEAR MOROVIS, PORTO RICO

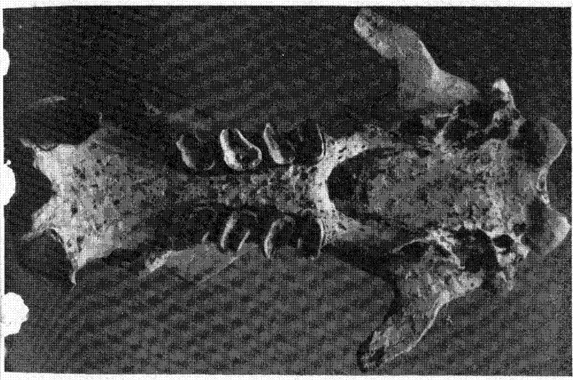




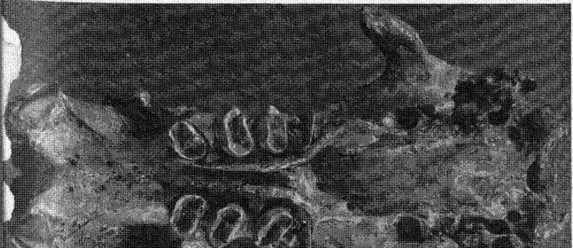
Two views of right scapula, No. 17716a, slightly less than natural size.

UNIV. OF H.

ACRATOCNUS ODONTRIGONUS, FROM NEAR MOROVIS, PORTO RICO



Skull, No. 17715, approximately four-fifths natural size.



Skull, No. 17720, approximately seven-ninths natural size.

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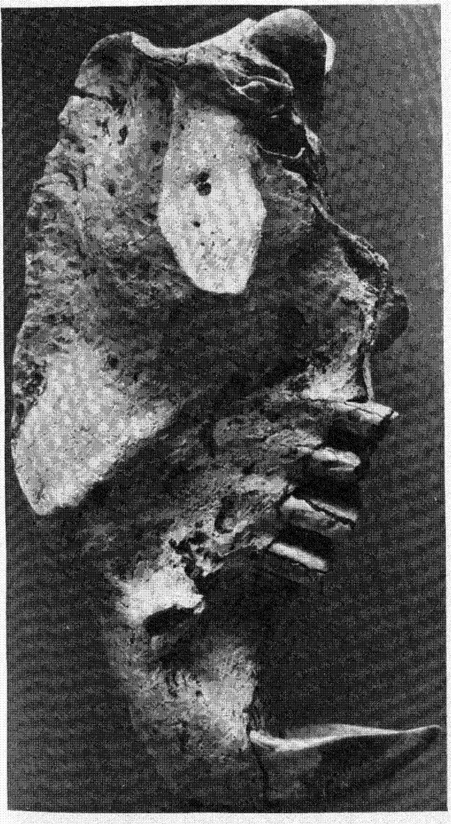

ACRATOCNUS ODONTRIGONUS, FROM NEAR MOROVIS, PORTO RICO

Skull, No. 17715, slightly greater than natural size.

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ACRATOCNUS MAJOR, FROM UTUADO, PORTO RICO
Figures natural size

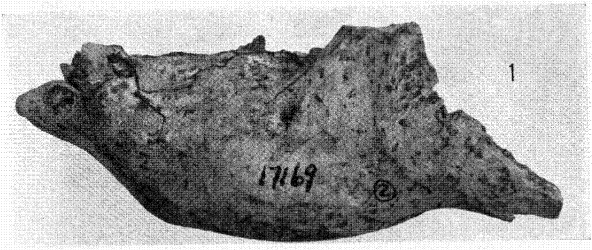

Fig. 1. Mandible, No. 17169, type.

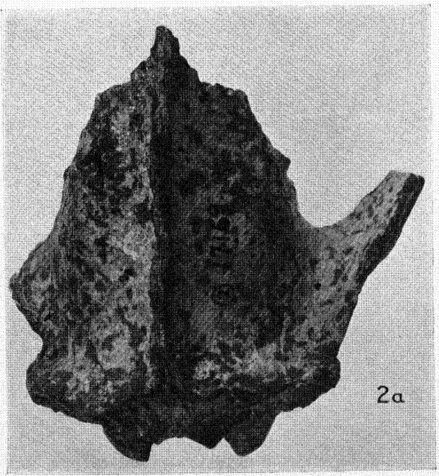

Fig. 2a. Fragment of skull, No. 17169, type.

ACRATOCNUS MAJOR, FROM UTUADO, PORTO RICO
Figures natural size

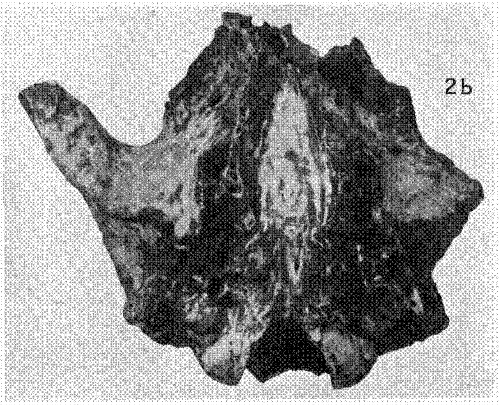

Fig. 2b. Basicranial region of skull, No. 17169, type.

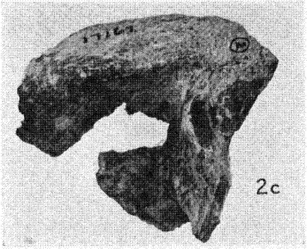

Fig. 2c. Orbital section, right side, of skull, No. 17169, type.

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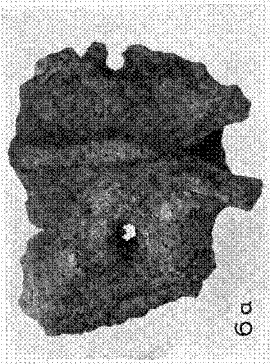
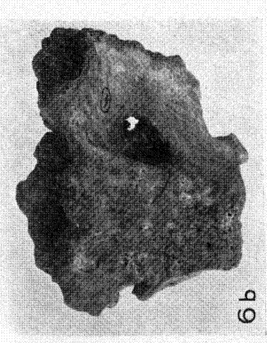
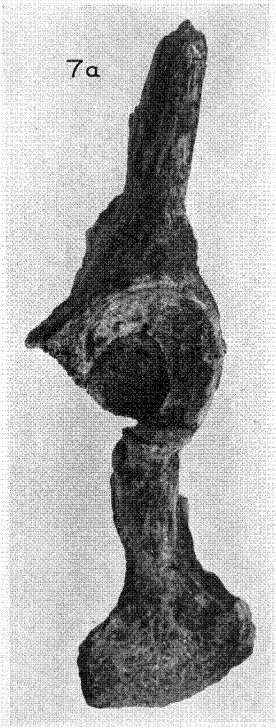


6a



6b



7a

Figures natural size

Figs. 6a, 6b. Fragments of sacrum, *Acratocnus odontrigonus*, Morovis, Porto Rico.
Fig. 7a. Left innominate, *Acratocnus major*, No. 17169, Utuado, Porto Rico.

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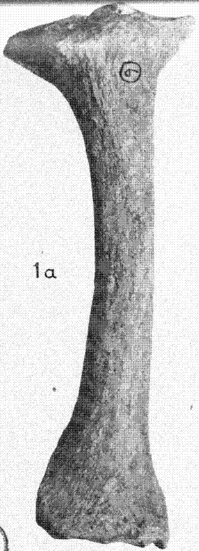
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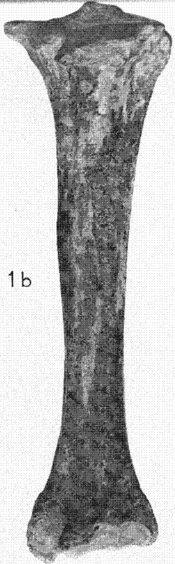
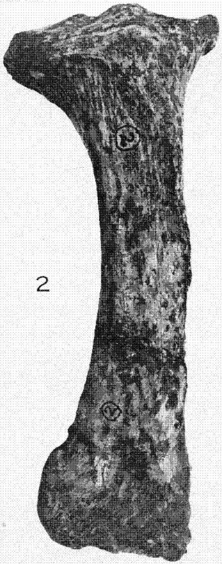

1b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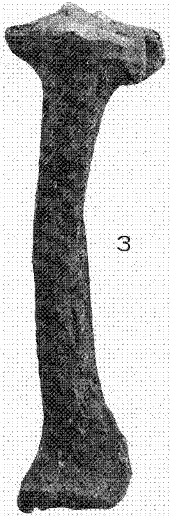
3

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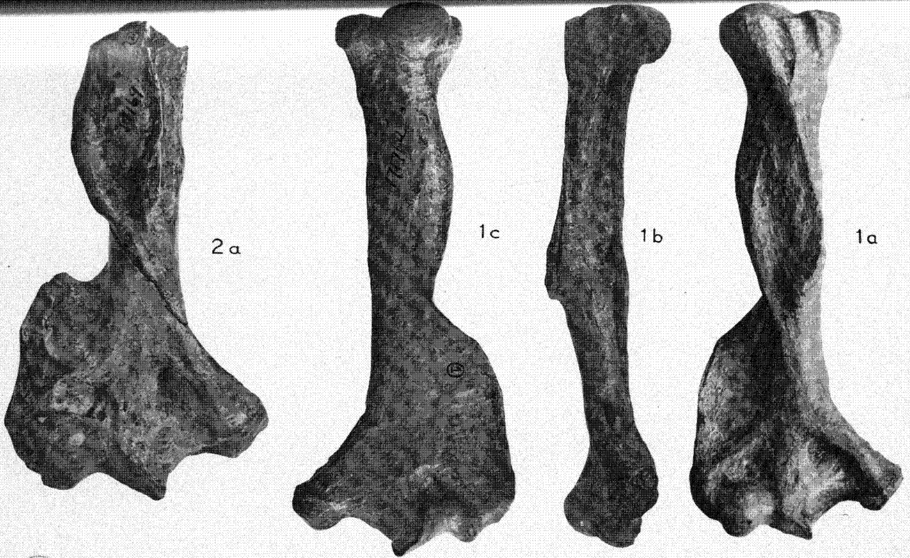
Figures about six-sevenths natural size

Figs. 1a, 1b. Right tibia, *Acratocnus odontrigonus*, No. 17175a, Morovis, Porto Rico.
Fig. 2. Right tibia, *Acratocnus major*, No. 17169, Utuado, Porto Rico.
Fig. 3. Left tibia, *Acratocnus odontrigonus*, No. 14170, Utuado, Porto Rico.



Figures eight-ninths natural size

Figs. 1a, 1b, 1c. Right humerus, *Acratocnus odontrigonus*, No. 17361a. Utuado, Porto Rico.
Fig. 2a. Right humerus, *Acratocnus major*, No. 17169, Utuado, Porto Rico.

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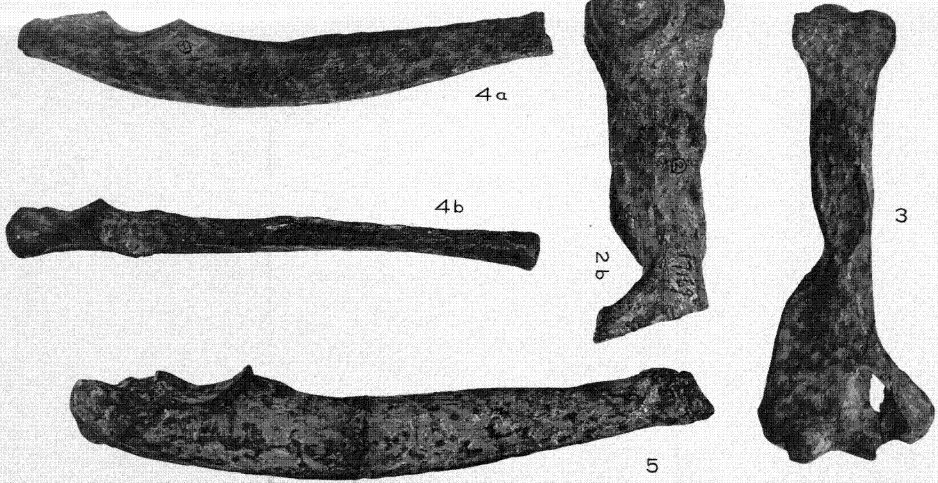

Figures seven-ninths natural size

Fig. 2b. Left humerus, *Acratocnus major*, No. 17169, Utuado, Porto Rico.
Fig. 3. Right humerus, *Acratocnus odontrigonus*, No. 17361d, Morovis, Porto Rico.
Figs. 4a, 4b. Left ulna, *Acratocnus odontrigonus*, No. 17362b, Utuado, Porto Rico.
Fig. 5. Left ulna, *Acratocnus major*, No. 17169, Utuado, Porto Rico.

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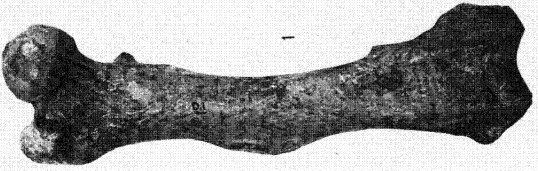

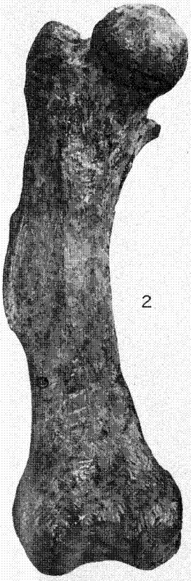

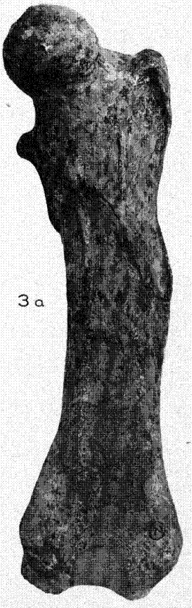

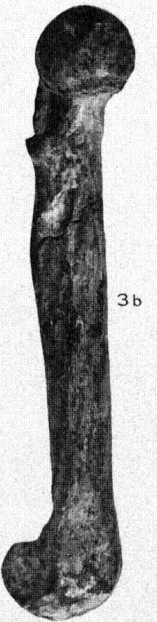

ACRATOCNUS ODONTRIGONUS

Figures about two-thirds natural size

Fig. 1. Right femur, No. 14170, Utuado, Porto Rico.
Fig. 2. Right femur, No. 17363a, Morovis, Porto Rico.
Figs. 3a, 3b. Left femur, No. 17363b, Utuado, Porto Rico.

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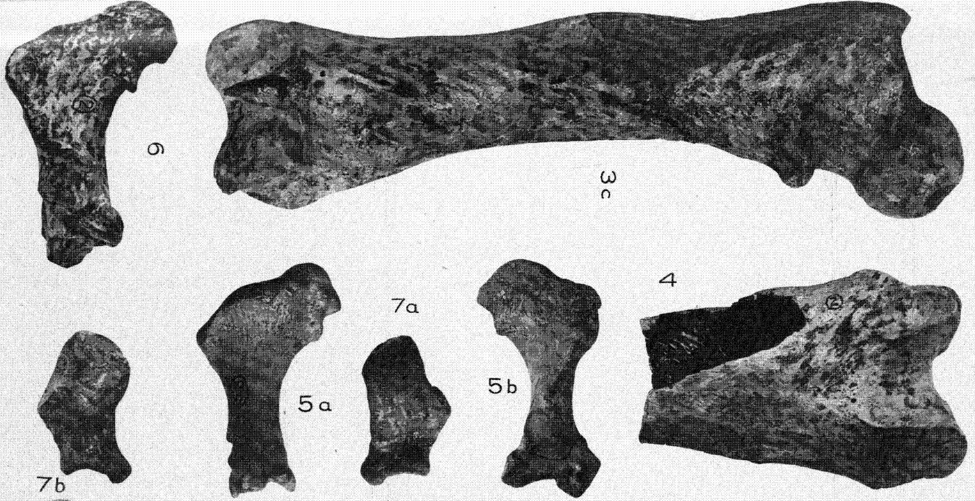

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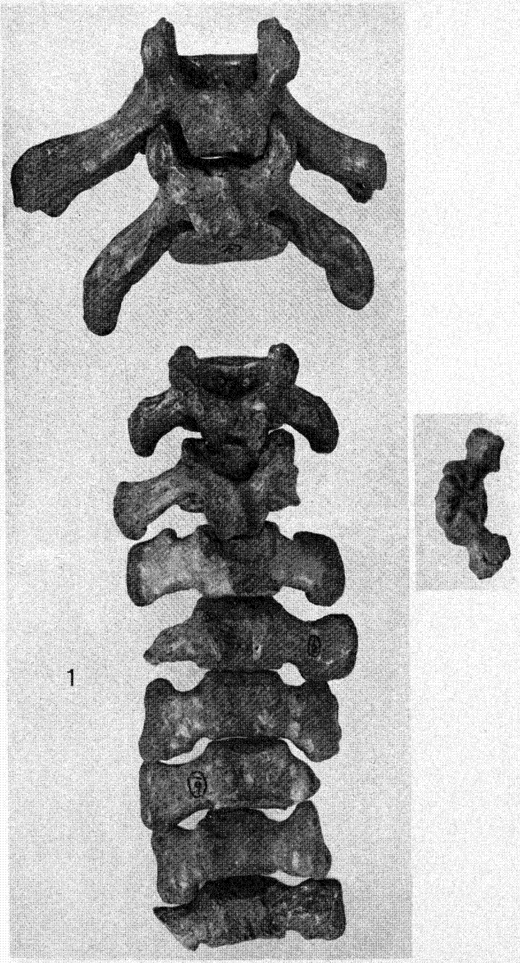
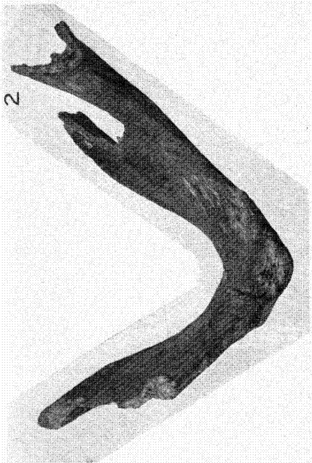
ACRATOCNUS, FROM UTUADO, PORTO RICO

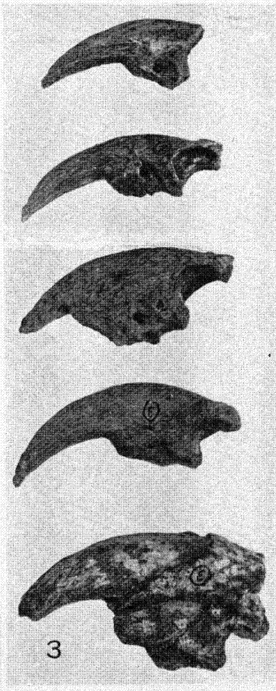
Figures about five-sixths natural size

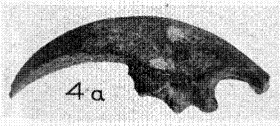
Fig. 3c. Left femur, *Acratocnus odontrigonus*, No. 17363b.
Fig. 4. Distal extremity of left femur, *Acratocnus major*, No. 17169.
Figs. 5a, 5b. Left calcaneum, *Acratocnus odontrigonus*, No. 17177a.
Fig. 6. Right calcaneum, *Acratocnus major*, No. 17169.
Figs. 7a, 7b. Left astragulus, *Acratocnus odontrigonus*, No. 17178a.

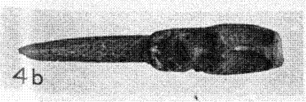


CAUDAL SERIES OF VERTEBRÆ OF ACRATOCNUS ODONTRIGONUS, DORSAL ASPECT, MOROVIS, PORTO RICO. × 1/1









Figures natural size

Fig. 2. Pubic region, *Acratocnus odontrigonus*, Utuado, Porto Rico.

Fig. 3. Ungual phalanges of *Acratocnus*, various individuals, Porto Rico.

Figs. 4a, 4b. Ungual phalanx, *Acratocnus odontrigonus*, Porto Rico.

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